Proposal for Information Collection
San Onofre Nuclear Generating Station
Southern California Edison

An *EDISON INTERNATIONAL* Company
San Onofre Nuclear Generating Station

Submitted In Compliance with
316(b) Phase II Regulatory Requirements

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List of Acronyms

BTA	Best Technology Available
CCC	California Coastal Commission
CDS	Comprehensive Demonstration Study
CRWQCB	California Regional Water Quality Control Board, San Diego Region
CWIS	Cooling Water Intake Structure
EPA	Environmental Protection Agency
FRS	Fish Return System
IM	Impingement Mortality
IM&E	Impingement Mortality and Entrainment
SCE	Southern California Edison
MSL	Mean Sea Level
MOU	Memorandum of Understanding
MRC	Marine Review Committee
NPDES	National Pollutant Discharge Elimination System
PIC	Proposal for Information Collection
PSIG	Pounds per Square Inch Gauge
SONGS	San Onofre Nuclear Generating Station

Table of Contents

ATTACHMENTS

List of Figures

EXECUTIVE SUMMARY

This Proposal for Information Collection (PIC) is submitted in compliance with the final 316(b) Phase II Rule (the Rule) for existing electric generating stations published in the Federal Register on July 9, 2004. This PIC provides the California Regional Water Quality Control Board, San Diego Region (CRWQCB-SD) with Southern California Edison's (SCE's) plans for:

- conducting necessary biological studies,
- evaluating alternative fish protection technologies, and
- evaluating the Rule's compliance alternatives.

It is SCE's intention to evaluate use of the full range of compliance alternatives based on the results of an impingement and entrainment study proposed for initiation in the spring of 2006. Based on the results of this study, a quantitative assessment of compliance alternatives will be conducted in 2007 to select the compliance alternative(s) to meet the Rule's applicable performance standards. Additional studies will be conducted as necessary to gather the information to prepare the Comprehensive Demonstration Study for submittal to SWRCB on or before January 7, 2008.

Receiving agency comments on the entirety of this PIC is important to SCE, but we recognize that agency resources are limited. A critical component of our 316(b) process is to conduct an Impingement Mortality and Entrainment Characterization (IM&E) study. Much of the rest of our evaluation of alternatives depends on the results obtained in the IM&E study, and sampling needs to be initiated as early as practical to ensure full evaluation of entrainment during a full fish spawning season (Pacific Ocean in the vicinity of San Onofre Nuclear Generating Station). Therefore, SCE specifically requests that CRWQCB-SD review and comment on the new study proposed and detailed in Section 4 and Appendix C of this PIC within the 60 day review period the Rule encourages for State's to provide PIC comments to facilities. SCE is anxious to obtain feedback on other aspects of the PIC, but since they are not as time sensitive, discussion on those aspects can wait until the spring of 2006.

1 INTRODUCTION

EPA signed into regulation new requirements for existing electric power generating facilities for compliance with Section 316(b) of the Clean Water Act on July 9, 2004 (the Rule). These regulations became effective on September 7, 2004 and are based on numeric performance standards[1]. The Rule at 125.94(a) (1-5) provides facilities with five compliance alternatives as follows:

1. *A facility can demonstrate it has or will reduce cooling water flow commensurate with wet closed-cycle cooling and be determined to be in compliance with all applicable performance standards. A facility can also demonstrate it has or will reduce the maximum design through-screen velocity to less than 0.5 ft/s in which case it is deemed in compliance with the impingement mortality (IM) performance standard (the entrainment standard still applies).*
2. *A facility can demonstrate that it has in place technologies and/or operational measures and/or restoration measures in place that will meet the applicable performance standards.*
3. *A facility can propose to install new technologies and/or operational measures and/or restoration measures to meet applicable performance standards.*
4. *A facility can propose to install, operate and maintain an approved design and construction technology.*
5. *A facility can request a site-specific determination of BTA by demonstrating that either the cost of installing technologies and/or operational measures and/or restoration measures are significantly greater than the cost for the facility listed in Appendix A of the rule or that the cost is significantly greater than the benefits of complying with the applicable performance standards.*

All facilities that use compliance alternatives 2, 3 and 4 are required to demonstrate a minimum reduction in impingement mortality (IM) of 80% (125.94(b) (1)). Facilities with a capacity factor that is greater than 15% that are located on oceans, estuaries or the Great Lakes or on rivers and have a design intake flow that exceeds more than 5% of the mean annual flow must also reduce entrainment by a minimum of 60% (125.94(b)(2)).

The Rule further requires that facilities using compliance alternatives 2, 3, and 5 prepare a Comprehensive Demonstration Study (CDS) as described at 125.95(b) of the Rule. There are seven components of the CDS and all facilities are required to submit components 1 (PIC), 2 (Source Waterbody Information if facility is on a river or reservoir), 3 (IM&E Characterization Study) and 7 (Verification Monitoring Plan).

[1] Performance standards are found at 125.94(b)

Facilities using compliance alternative 1 are not required to submit a CDS and those using compliance alternative 4 are only required to submit the Technology Installation and Operation Plan (TIOP) and Verification Monitoring Plan. All facilities that use compliance alternatives 2, 3 and 5 are required to prepare and submit components 1, 2, 3 and 7 but depending on the compliance alternative(s) selected will submit either component 4 (Design and Construction Technology Plan and Technology Installation and Operation Plan), 5 (Restoration Plan) or 6 (information to support site specific BTA determination). The first component required for submittal is the "Proposal for Information Collection" (PIC), the first component of the CDS. The Rule at 125.95(b)(1) requires that the PIC include:

1. *A description of the proposed and/or implemented technologies, operational measures, and/or restoration measures to be evaluated in the Study.*
2. *A list and description of any historical studies characterizing impingement mortality and entrainment (IM&E) and/or the physical and biological conditions in the vicinity of the cooling water intake structures (CWIS) and their relevance to this proposed Study. If you propose to use existing data, you must demonstrate the extent to which the data are representative of current conditions and that the data were collected using appropriate quality assurance/quality control procedures.*
3. *A summary of any past or ongoing consultations with appropriate Federal, State, and Tribal fish and wildlife agencies that are relevant to this Study and a copy of written comments received as a result of each consultation.*
4. *A sampling plan for any new studies you plan to conduct in order to ensure that you have sufficient data to develop a scientifically valid estimate of IM&E at your site. The sampling plan must document all methods and quality assurance/quality control procedures for sampling and data analysis. The sampling and data analysis methods you propose must be appropriate for a quantitative survey and include consideration of the methods used in other studies performed in the source waterbody. The sampling plan must include a description of the study area (including the area of influence of the CWIS(s)), and provide a taxonomic identification of the sampled or evaluated biological assemblages (including all life stages of fish and shellfish).*

An important feature of the Rule is use of the calculation baseline. The calculation baseline is defined as follows:

Calculation baseline means an estimate of impingement mortality and entrainment that would occur at your site assuming that: the cooling water system has been designed as a once-through system; the opening of the cooling water intake structure is located at, and the face of the standard 3/8-inch mesh traveling screen is oriented parallel to, the shoreline near the surface of the source waterbody; and the baseline practices, procedures, and structural configuration are those that your facility would maintain in the absence of any structural or operational controls, including flow or velocity reductions, implemented in whole or in part for the purposes of reducing impingement *mortality and entrainment. You may also choose to use the current level of impingement mortality and entrainment as the calculation baseline. The calculation baseline may be estimated using: historical impingement mortality and entrainment data from our facility or another facility with comparable design, operational, and environmental conditions; current biological data collected in the waterbody in the vicinity of your cooling water intake structure; or current impingement mortality and entrainment data collected at your facility. You may request that the calculation baseline be modified to be based on a location of the opening of the cooling water intake structure at a depth other than at or near the surface if you can demonstrate to the Director that the other depth would correspond to a higher baseline level of impingement mortality and/or entrainment.*

This definition allows existing facilities with a variety of study options to take credit for facility features that deviate from the calculation baseline and provide the benefit of fish protection. Facilities can also simply develop the baseline by documenting IM&E.

2 DESCRIPTION OF FACILITY

San Onofre Nuclear Generating Station (SONGS) is located on the Pacific Ocean approximately 2.5 miles southeast of San Clemente California along the Southern California Bight in north San Diego County. The facility currently consists of two nuclear fueled generating units (Unit 2 & Unit 3) each rated at 1,087 MWe. SONGS is considered a baseloaded facility and in 2003, the average capacity factor for the entire facility was 96.9%.

The design of the Cooling Water Intake Structure (CWIS) deviates significantly from the Rule's calculation baseline. Deviations that provide the benefit of fish protection include use of an offshore submerged intake and velocity cap in combination with a fish collection and return system (FRS). Figure 1 shows the offshore intake and velocity cap while Figure 2 provides a plan view of the on shore CWIS and FRS. Units 2 and 3 each have submerged intakes located 3,183 ft offshore with the cooling water intake located at a depth of 32 ft. Condenser cooling water for each Unit flows through an 18 ft internal diameter submerged pipe to where the rest of the CWIS is located on shore within the facility. On shore the cooling water passes through a series of vanes and louvers located in front of the traveling screens. The louvers also function as bar racks designed to prevent large debris from entering the CWIS. The louvers and vanes are designed to encourage fish based on pressure differentials to move to a quiet water area at the end of the intake where the fish return system (FRS) is located. In addition to the louvers, a "fish chase" procedure using elevated temperatures is used to further force fish into the FRS collection area prior to heat treatments[2]. The cooling water for each of the two Units, after passing through the bar racks, passes through six traveling screens located in parallel. It then is pumped through each Unit's four 202,750 gpm circulating water pumps where it flows to the condensers. The through-screen water velocity of the traveling screens is 3.0 fps.

Because SONGS is located on the Pacific Ocean with a capacity factor in excess of 15% it is subject to both the impingement and entrainment performance standards.

[2] Heat treatments are conducted approximately every 6 weeks at each unit to control the growth of fouling organisms such as mussels and barnacles. Water temperatures in the screenwell reach approximately 105°F. during the heat treatment. Prior to the heat treatment, a "fish chase" is performed to get as many fish out of the system as possible. During the fish chase the water is heated to a sub-lethal temperature that agitates the fish enough to make them move to the fish return elevator for return to the ocean.

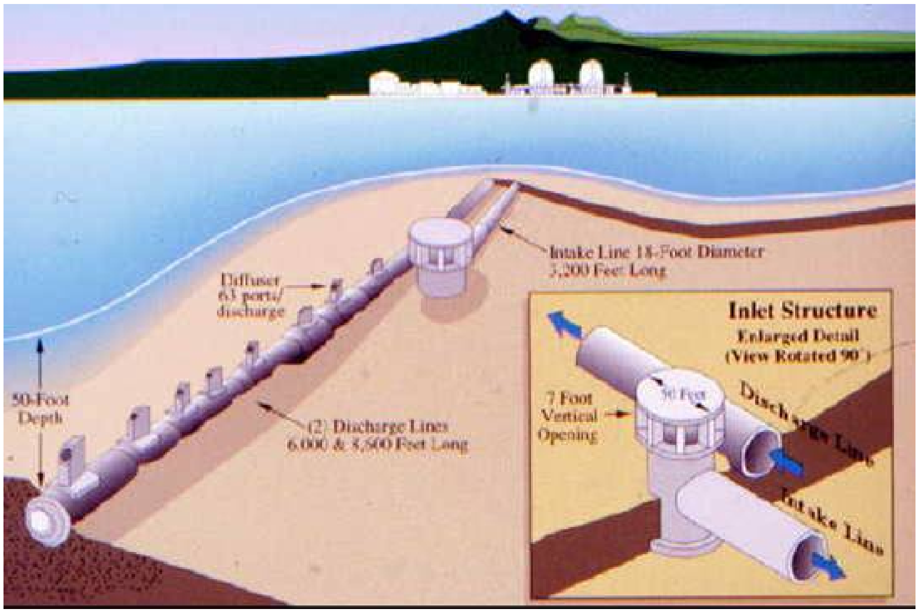

Figure 1 - Schematic of SONGS submerged offshore intake and velocity cap

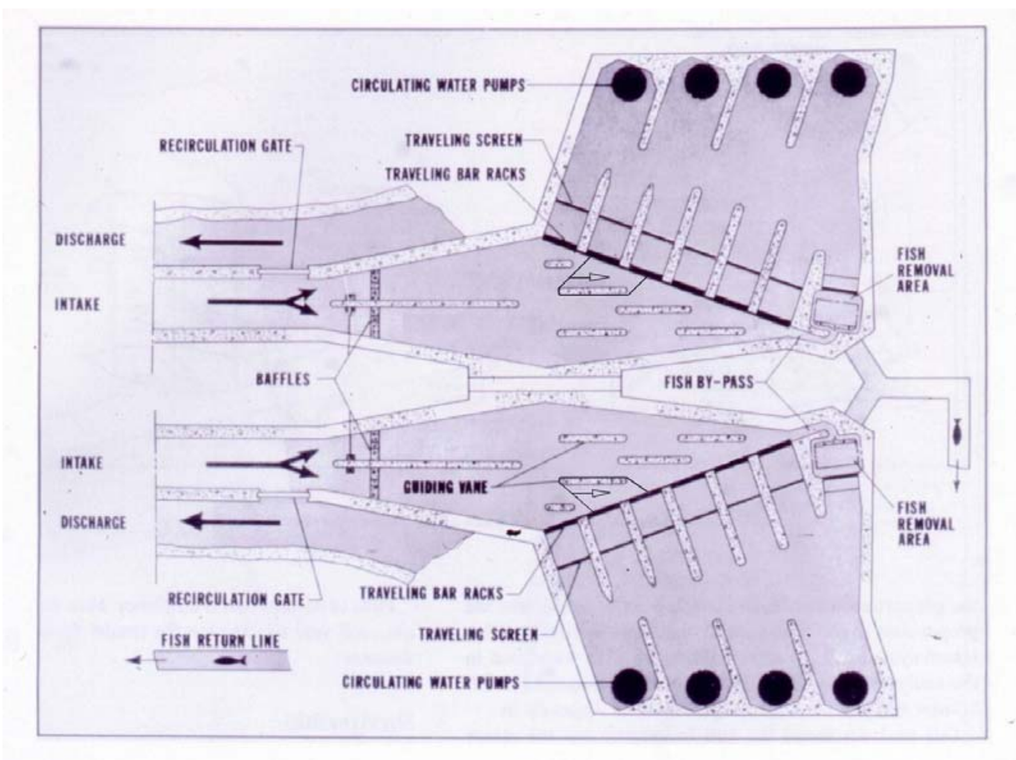

Figure 2 - Top view of SONGS on shore cooling water intake structure and fish return system

3 COMPLIANCE ALTERNATIVES TO BE EVALUATED

In the strategic compliance plan submitted to the RWQCB, SCE expressed its preferred compliance alternatives for preparation of the Comprehensive Demonstration Study (CDS). Each of the Rule's options and compliance alternatives to be evaluated for use at SONGS and some of the issues currently identified with these alternatives are discussed below.

3.1 Existing Use of an Offshore Intake with a Velocity Cap combined with FRS under Compliance Alternative 2 to meet the IM Performance Standard

The Rule specifically entitles facilities to take credit for deviations from the calculation baseline defined in Section 1 above that provide the benefit of fish protection. As discussed in Section 2, SONGS has a number of CWIS design and operational deviations specifically used to provide fish protection. These systems include:

- Use of an offshore intake with a velocity cap
- Fish guidance system using louvers and vanes
- Fish heat chase operational procedures (guide fish to collection point)
- Fish collection and return system (i.e. FRS)

The effectiveness of these systems have been previously documented in NOAA Technical Report NMFS 76 (April 1989) and in "Review of Southern California Edison, San Onofre Nuclear Generating Station (SONGS) 316(b) Demonstration" (June, 1994). These reports indicate that the installed design features used in combination with operational features are achieving a high level of protection to impingeable organisms that are expected to meet the 80% - 95% IM reduction performance standard.

SCE believes that the systems listed above may also provide some benefit to entrainable life stages. First, observations of the FRS indicated that in addition to impingeable life stages (defined in the Rule as species of fish and shellfish that cannot pass through 3/8 in mesh traveling screens) numerous larger entrainable life stages (defined in the Rule as species of fish and shellfish that will pass through 3/8 inch mesh traveling screens) are collected in the fish collection tray and transported offshore. SCE plans to collect data to quantify the species and life stage of these fish to determine the potential for credit against the entrainment performance standard. The proposed study is discussed in Section 4 of the PIC below. Secondly, SCE believes that due to the behavior of larger entrainable species such as anchovies (one of the dominant species entrained) entrainment may be reduced due to the location of the intake in the water column. This deviation of SONGS from the Rule's calculation baseline will also be evaluated for potential credit.

3.2 Use of Restoration under Compliance Alternative 3 to Meet the Entrainment Reduction Performance Standard

The EPA final Phase II Rule provides that applicants may use restoration measures in addition to, or in lieu of, technology measures to meet performance standards or in establishing best technology available (BTA) on a site-specific basis. The basic philosophy of restoration is mitigation of fish losses at a CWIS by either direct supplementation (stocking) of a "species of concern" potentially impacted by the CWIS, or provision, protection and restoration of habitat that "produces" fish and thereby replaces those lost due to IM&E.

SCE has negotiated with the California Coastal Commission (CCC) construction of a wetland restoration project to mitigate the entrainment impacts at SONGS. The agreement includes restoration of 150 acres of wetland restoration as part of the overall San Dieguito River Valley Regional Open Space Park project. Consistent with requirements for use of restoration the agreement includes funding of monitoring to ensure that the project goals are attained. Additionally, the project includes partial funding of a white sea bass fish hatchery that will provide additional restoration benefits. The planned coastal restoration project was designed to offset losses of mid-water fish species based on an IM&E analysis conducted in the 1980's. SCE in conformance with the Rule is proposing to conduct new IM&E studies to establish the calculation baseline based on current data (see Section 4). Based on the new data SCE will verify that the planned restoration project in combination with the fish hatchery will be adequate to meet the performance standards, supplemented by the currently installed fish protection technologies and operational measures previously discussed[3].

3.3 Use of Fish Protection Technologies and/or Operational Measures under Compliance Alternatives 3 and 4

In conjunction with other state and federal agencies, SCE has evaluated use of additional fish protection technologies and operational measures. The last technologies evaluated were use of light and sound behavioral devices that act as fish deterrents to impingeable organisms. In October 2000 the CCC concluded that these devices were not effective and testing was no longer necessary. In the event that use of restoration measures is not

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[3] SCE is aware that use of restoration is currently the subject of Phase II Rule litigation. The Second Circuit Court ruled that restoration could not be used for compliance with the 316(b) Phase I Rule. Based on the Phase I litigation decision, EPA added significant text to the Phase II Rule to support its use in Phase II. SCE plans to monitor litigation developments in 2005 and early 2006. It is SCE's current understanding that the Phase II Rule litigation decision should be rendered in spring 2006, approximately the same time that results of the proposed IM&E sampling data will become available. When both the IM&E study data necessary for restoration scaling and results of the litigation are available, SCE can quantitatively verify that the amount of restoration in the current agreement is adequate to meet the entrainment reduction standard.

available for compliance to offset entrainment losses, SCE plans to continue to evaluate use of additional technologies, including use of narrow slot wedgewire screens and fine mesh Ristroph screens. Each is discussed as follows:

Narrow-slot cylindrical wedgewire screens have the potential to reduce both IM&E. These screens would replace the existing velocity caps. Cooling water for each unit would be conveyed through 49 separate cylindrical wedgewire screens, each 84-in. diameter, submerged, and mounted on intake pipes connected to the existing intakes (Figure 3 and Figure 4). Wedgewire screen are typically designed to meet the entrainment standard by using 0.5 mm slots. Depending upon the size of entrained organisms (determined from the results of the IM&E study or from historical entrainment sampling), larger slots may be as effective in reducing entrainment at a substantially lower cost. In addition, the industry standard design for wedgewire screens is a maximum slot velocity of 0.5 ft/sec which meets the IM standard using compliance alternative 1. The screens, as designed, have the potential to decrease the entrainment of fish eggs and larvae, but the degree of protection will vary by species and life stage and no testing has been conducted for species in the vicinity of SONGS.

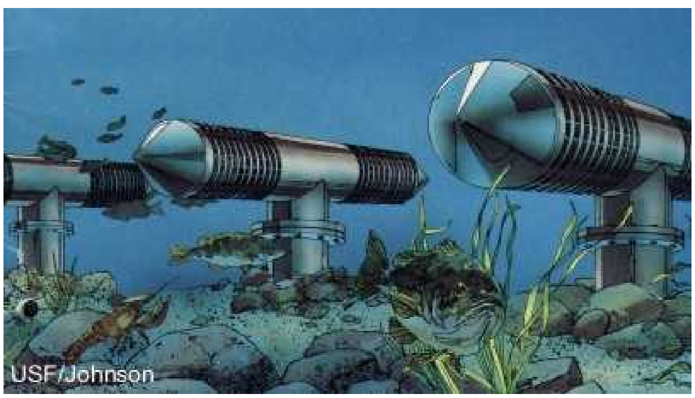

Figure 3 – Illustration of cylindrical wedgewire screens (compliments of US Filter and Johnson)

Figure 4 – An estimated 49 modules slightly smaller than the sized shown in the photograph would be required for SONGS (photo compliments of US Filter and Johnson).

The orientation of the screens relative to the existing pipes will depend on the currents in the area. The screens should be positioned parallel to the predominant current to lessen the affects of debris buildup and to facilitate cleaning. The spacing between screens and the length of the new pipe will depend on the screen orientation. An air backwash system, complete with necessary air compressors and controls, would be installed to clean the wedgewire screens. The air backwash system could be an effective method for maintaining the wedgewire screens in a clean condition. Local currents, resulting from tide changes and coastal currents in the area should be sufficient to transport debris and organisms away from the screens. Periodic manual cleaning for removal of biofouling agents would likely be necessary. However, it is important to note that these screens have yet to be deployed in a marine environment and demonstrating the ability of the air backwash system will be critical for a nuclear facility such as SONGS.

Approach velocities at the wedgewire screens would be similar to tidal or other ambient currents. The maximum through-slot velocity would not exceed 0.5 ft/sec. Head losses through the screens should not exceed 1 ft (assuming biofouling would not be a significant problem). Except for the slightly lower water level, flow characteristics in the intake pipe leading to the screenbay would not be any different than the existing intake. Flow patterns to the pumps would not change from the existing conditions.

The existing traveling screens would not be necessary and could be removed with narrow-slot wedgewire screens. The fish return system would also no longer be required. Because of the low through-screen velocity, wedgewire would automatically meet the IM standard via Compliance Alternative 1 (0.5 ft/sec through-screen design velocity criterion).

Install Fine-mesh Ristroph Traveling Water Screens. SCE will also evaluate replacing the existing 3/8 in. traveling water screens for both units 2 and 3 with new 0.5 mm fine-mesh Ristroph screens (Figure 5 and Figure 6). Fine-mesh screens are typically designed with an approach velocity of 0.5 ft/sec to increase the survival of fish eggs and larvae. This velocity is about one-fourth the velocity approaching the existing traveling water screens. Due to exceeding the velocity criteria it will be critical to perform laboratory and/or field studies to verify that the survival of entrainable organisms is higher than the existing survival through the condenser system. If impingement survival of entrainable organisms is low, the screenhouse would need to be expanded to accommodate nine additional screens necessary to reduce the approach velocity. Such an expansion would require each unit to be shutdown for a substantial amount of time and would require considerable site work. For these reasons, expansion of the intake and installing more Ristroph screens is not considered to be a cost-effective solution.

Figure 5 – Illustration of Ristroph fish collection bucket

Figure 6 – Photograph of fine mesh screen panels on a screen test device

Impinged organism would be removed from the fine-mesh Ristroph screens via a low-pressure spray wash (~10 psi) and washed into a fish return trough. This fish return trough could be tied into the existing fish return system.

Northern anchovy eggs are broadcast throughout the water column and are typically found floating near the surface and therefore may be entrained in reduced numbers through the velocity cap. However, northern anchovy eggs should be large enough to be physically prevented from passage through fine-mesh screens. Larval length of northern anchovy at hatching is between 2.5 and 3.0 mm; therefore, the majority of larvae should be prevented from being entrained. A second factor to consider with fine mesh screens is that such screens result in the impingement of fish that were previously entrained. Use of fine mesh screens is a tradeoff. Some species and life stages benefit, but others might experience greater mortality than under existing conditions. These screens are beneficial from an organism protection viewpoint only if impingement survival for abundant species is relatively high and exceeds entrainment survival levels. Past studies show that anchovy have relatively low survival following impingement on fine mesh screens. Immediate survival of anchovy larvae was reported to be 31 to 66% when adjusted for control survival (depending upon velocity and duration of impingement) (Edwards et al. 1981). Post-impingement survival of bay anchovy (Anchoa mitchilli), which is in the same family as northern anchovy, has ranged from 0 to 37% (Brueggemeyer 1988; LMS 1987). Therefore, this technology may not be effective for reducing entrainment mortality for species entrained at SONGS.

Use of an Approved Technology under Compliance Alternative 4. Currently use of wedge wire screens in rivers that meet certain criteria is the only named EPA pre-approved technology. However the Rule provides a process that allows additional technologies to become listed pre-approved technologies. New technologies can be so designated by providing information to demonstrate that if installed in the waterbody type the technology would have little trouble meeting performance standard for which they are pre-approved.

When results of the proposed IM&E sampling are available in 2006, if use of restoration measures are not available and SCE decides to comply using one or a combination of technology and/or operational measures, it may propose pilot studies in the 2006/2007 time frame to verify performance.

Now that the final 316(b) Rule is in place, a good deal of interest has been generated in developing new fish protection technologies. SCE plans to monitor the development and testing of new technologies for potential use. If other technologies more effective in terms of fish protection efficacy and cost-effectiveness become available, SCE will inform CRWQCB-SD that the new technology may be added to the PIC for evaluation at SONGS.

3.4 Use of Site Specific Standards under Compliance Alternative 5

SCE plans to evaluate potential use of both the cost-cost and cost-benefit tests under compliance alternative 5. Use of these alternatives are provided so that facilities are not required to pay costs that would be considered significantly greater than either the costs estimated by EPA for facilities or the economic value of the site specific environmental benefits that will be achieved. Should the evaluation of the current impingement reduction technologies and operational measures determine that the IM performance standard is not met or use of restoration for offsetting entrainment losses is not available these tests will be used to evaluate the cost of technologies.

EPA, in developing the national cost of implementing the Rule, considered the cost for each Phase II facility to comply. If the actual cost estimated for a facility to meet the performance standard, based on a site specific analysis, is determined to be significantly greater than the cost estimated by EPA for the facility to comply, the facility can apply for a site specific standard under the cost-cost test. The site specific standard would be that achieved by the use of the best performing technology (i.e. achieve the highest level of protection) or operational measure that would pass the cost-cost test.

The economic value of the environmental benefit of meeting the performance standards will also be evaluated under the cost-benefit test. This analysis cannot be conducted until the proposed 2005/2006 IM&E study is completed, since those data, in combination with previously collected IM&E study data, will serve as the basis for the environmental benefit quantification. A description of the method to be utilized for the cost-benefit test is provided in Attachment B.

4 BIOLOGICAL STUDIES

The Rule requires that a summary of historical IM&E studies and/or physical and biological studies conducted in the vicinity of the CWIS be provided, as well as, study plans for any new IM&E studies. IM&E studies were previously conducted at SONGS. Entrainment sampling was conducted at Unit 1 over a one year period that started in August 1979 and concluded at the end of July 1980. Units 2 and 3 were extensively studied from 1979 through 1986 by the Marine Review Committee to estimate entrainment losses due to operation of the SONGS. Weekly impingement sampling was conducted from 1983 – 1994 then frequency was reduced to monthly sampling from 1994 – 1998 and was reduced again to quarterly sampling since 1999. Due to the age of entrainment studies, a new study is proposed to be initiated in 2006 and sampling will be conducted on a bi-weekly basis. Also, due to the reduced impingement sampling in recent years, SCE plans to conduct a year of impingement sampling at a biweekly sampling frequency. Proposed sampling will also include quantification of later entrainable stages collected in the FRS in order to establish credit towards the calculation baseline for entrainment reduction. The historical IM&E studies, other biological information and proposed new studies are fully described in Attachment A.

5 SUMMARY OF CONSULTATIONS WITH AGENCIES

The Rule requires that "a summary of any past or ongoing consultations with appropriate Federal, State, and Tribal fish and wildlife agencies that are relevant to the CDS and a copy of written comments received as a result of such consultations be provided". The California Coastal Commission (CCC) has a long standing involvement in the evaluation of the effects of the SONG's CWIS on local fish and shellfish. This involvement includes negotiating the currently planned restoration projects designed to mitigate effects of the CWIS to mid-water fish not addressed by the installed fish protection technologies and operational measures. There are numerous documents in the public record regarding these negotiations that have already been provided to the CRWQCB-SD. Attachment C provides a copy of the most recent progress report.

6 SCHEDULE FOR INFORMATION COLLECTION

The Rule allows facilities with NPDES permits that expire within four years of the date of publication of the Rule in the Federal Register (July 9, 2004) up to three and a half years to submit the fully completed CDS (125.95(2) (ii)). SCE considers this to be a very short timeframe and believes the full three and a half years will be required to complete all required elements of the CDS for SONGS. The Rule also requires a PIC to be submitted to the SWRCB prior to initiating new 316(b) studies. While the Rule allows facilities to initiate studies after PIC submittal, SCE realizes it prudent and reasonable to provide time for SWRCB to review and comment on the IM&E study plan. The Rule encourages that SWRCB provide comments within 60 days of PIC submittal to allow SCE time to make any necessary modifications prior to initiating the IM&E studies.

In order to make a final compliance alternative(s) determination for SONGS, it will be necessary to evaluate the results of the one year 2005/2006 IM&E samples, along with the previously collected historical impingement and entrainment data. It is anticipated that after the conclusion of the one year of proposed IM&E data collection, it is likely to take a minimum of 4-6 months to complete the processing of collected entrainment data, input results into a database, review QA/QC information, and analyze the data for use in compliance decision-making. This should allow SCE to quantitatively evaluate the various compliance alternatives discussed in Section 3 of the PIC. Also, it is anticipated that within this time frame, the Court will issue a decision on the on-going Phase II litigation, so that any impact of that decision on the currently available compliance alternatives and compliance options can be considered in making SCE's final compliance decision. If restoration is still available, SCE will verify based on the IM&E study results that the current restoration project in combination with the existing fish protection technologies and operational measures are adequate to meet the IM&E performance standards. The IM&E analysis also will allow quantification of the economic benefits in order to evaluate potential use of the compliance alternative 5 cost-benefit test based on technology and operational cost estimates developed in 2005 if necessary. Finally, the IM&E study results also may also be used to evaluate the feasibility, efficacy or cost of the alternative technologies and/or operational measures being evaluated.

SCE then plans to use the remainder of 2006 and the early part of 2007 to conduct the necessary work to develop the information needed to complete the CDS. If restoration is to be used for compliance, a Restoration Plan will be prepared in conformance with the Rule based on the currently planned restoration projects. In addition, a Design and Construction Technology Plan and Technology Installation and Operation Plan will be prepared based on the currently employed fish protection technologies and operational measures, as well as a Verification Monitoring Plan. If use of site-specific standards is used for compliance, work on the necessary documents, including the Comprehensive Cost Evaluation Study, Benefits Valuation (if the Cost-Benefit Test is used) and Site-Specific Technology Plan, would be prepared during this 2006-2007 period.

The Rule recognizes that the CDS studies are an iterative process[4] and allows facilities to modify the PIC based on new information. SCE may request SWRCB approval of an amendment to this PIC, based on new information relative to technologies and operational measures, use of restoration measures, Phase II Rule litigation or subsequent Agency guidance.

[4] See Rule preamble first column pg 41235 of Federal Register/Vol. 69, No. 131/Fri 7/9/04.

A SUMMARY OF EXISTING BIOLOGICAL INFORMATION AND SAMPLING PLAN FOR IM&E STUDY

See following pages.

SUMMARY OF EXISTING BIOLOGICAL INFORMATION AND SAMPLING PLAN FOR THE IMPINGEMENT MORTALITY AND ENTRAINMENT CHARACTERIZATION STUDY AT THE SAN ONOFRE NUCLEAR GENERATING STATION

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SAMPLING PLAN SUMMARY

An impingement and entrainment sampling plan is proposed for the San Onofre Nuclear Generating Station (SONGS or the “Station”), a 2,174-MW facility located in San Diego County, California on the Pacific Ocean. The station is subject to the Clean Water Act §316(b) Phase II Rule for its NPDES permit, which requires that impingement mortality be reduced by 80 to 95 percent and that entrainment be reduced by 60 to 90 percent, compared to a baseline level specifically determined for the facility. To comply with this Rule, the proposed sampling plan will provide information required to complete an Impingement Mortality and Entrainment Characterization Study. This sampling plan: 1) identifies existing data on the fish community in the vicinity of the cooling water intake and on impingement and entrainment occurring at the intake; 2) evaluates the sufficiency of these data to characterize current fish abundance, distribution, impingement, and entrainment at the intake; and 3) describes a work scope for impingement and entrainment monitoring.

SONGS has a long history of extensive studies on the effects of its operation on the aquatic community and the performance of its cooling water intake system (CWIS) in reducing impingement losses. The Station’s CWIS differs from the hypothetical shoreline intake defined by the Phase II Rule for use as the “calculation baseline”. For example, SONGS has an offshore intake and incorporates fish protection measures, including a velocity cap and fish diversion and return system (FRS). Southern California Edison (SCE) has submitted assessments of entrainment and impingement impacts in prior §316(b) demonstrations for SONGS and numerous technical reports. These studies and assessments have been subject to extensive regulatory review which concludes that the intake is best technology available for reducing impingement impacts (SAIC 1994). Impingement abundance monitoring has been conducted every year since 1983, while entrainment abundance monitoring was conducted at Unit 1 in 1979 and 1980 and at Units 2 and 3 from 1982 through 1986.

Because there are no recent data on entrainment at SONGS, entrainment abundance monitoring is proposed to update the existing data to reflect present conditions in the SONGS study area and current operation of the station. In contrast, the impingement abundance monitoring data at SONGS is extensive. However, since recent impingement monitoring has been relatively infrequent (monthly or quarterly since 1994), additional impingement abundance monitoring is proposed to provide a current and comparable data set on both entrainment and impingement that adequately accounts for temporal variations throughout the year. Special studies on effectiveness of the fish diversion and return system are also proposed to update prior studies, and investigate the potential effectiveness of the FRS in reducing entrainment of late larval and juvenile fish. Data produced by the entrainment abundance monitoring will define the species and life stages currently being entrained, as well as their numbers and length distributions on a time (daily and annual) and per-volume-pumped (million gallons (MG) of cooling water) basis. Data produced by the FRS effectiveness studies will provide additional information to characterize FRS-related reductions in impingement and entrainment relative to the calculation baseline.

The table below summarizes the proposed features of the impingement and entrainment sampling programs.

SAN ONOFRE NUCLEAR GENERATING STATION SAMPLING PROGRAM SUMMARY

Program	Duration	Sampling Frequency	Data Collected
Impingement Monitoring	1 year	Biweekly – One 24-hour sample every two weeks, year-round plus heat treatments.	Counts and biomass by species and life stage, length frequency, scale/otolith samples, specimen condition, collection efficiency, ancillary environmental and operation data
Fish Chase	1 year	Concurrent with all heat treatment operations at both Units 2 and 3.	Estimated count and biomass of all identifiable fish and target invertebrates.
Entrainment Monitoring	1 year	Approximately biweekly for one year; plankton net samples taken from intake screenwell[1]– 4 samples at 6-hr intervals covering a 24-hour period, year-round. Sample schedule may vary depending on heat treatment and maintenance outage schedules.	Counts and densities (#/volume) by species and life stage, length frequency of target taxa, ancillary environmental and operation data
Source Water Plankton Monitoring	1 year	Monthly at 6-hour intervals over 24-hour period, coinciding, when possible, with in-plant entrainment monitoring.	Counts and densities of fish larvae and targeted invertebrate larvae by species and life stage, length frequency of target taxa, ancillary environmental and operational data.
FRS Studies (impingement & entrainment)	1-year	Bi-weekly, concurrent with impingement samples. Samples netted from fish return elevator. 4 samples at 12-hr intervals covering 24-hr period.	Counts and biomass by species and life stage, length frequency of target taxa, and condition (i.e., any indication of impaired swimming ability in elevator.

[1] A pilot study will be conducted to compare plankton net samples, taken as close as possible to the offshore intake, to samples taken in-plant at the circulating water pump inlet to determine the best sampling procedure.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

ASA Analysis & Communication, Inc. has prepared this Impingement and Entrainment Sampling Plan for Southern California Edison as groundwork for compliance with SCE's Clean Water Act Section 316(b) compliance obligations with the California Regional Water Quality Control Board, San Diego Region (CRWQCB) for the San Onofre Nuclear Generating Station (SONGS). SONGS is located on the Southern California coastline between San Clemente and Oceanside, CA. Under the Clean Water Act §316(b), an NPDES permit applicant must demonstrate that the location, design, construction and capacity of its cooling water intake structure represents Best Technology Available (BTA) for minimizing adverse environmental impact. The primary impacts of concern under §316(b) are entrainment of smaller aquatic organisms into the cooling water system and impingement of larger organisms onto traveling screens in the cooling water intake. However, other impacts associated with various technology or operating alternatives also are considered in reaching a BTA decision.

1.1 PHASE II §316(b) REQUIREMENTS

On July 9, 2004, the United States Environmental Protection Agency (EPA) published its final Phase II Rule promulgating regulations to implement CWA §316(b). The Phase II Rule applies to existing electric generating facilities (construction commenced prior to January 17, 2002) that have cooling water intake structures (CWIS) with a design capacity of 50 million gallons per day (MGD), withdraw water from waters of the U.S., and use 25 percent or more of the water withdrawn for cooling purposes. SONGS fits this definition for a Phase II facility. Compliance with the Phase II Rule is based on achieving performance standards for reduction of impingement mortality and entrainment set by the EPA on the basis of facility location. The Rule requires that impingement mortality be reduced by 80 to 95 percent and entrainment be reduced by 60 to 80 percent, compared to a baseline level (i.e., the calculation baseline) specifically determined for the facility. As a result of being located on the Pacific Ocean and having a capacity utilization rate of greater than 15 percent, SONGS is subject to entrainment reduction performance standards, as well as impingement mortality reduction standards.

The calculation baseline is a hypothetical condition representing an intake structure located at the surface and along the shoreline of the source waterbody. The hypothetical intake would have the screen face parallel to the shoreline and traveling screens with the standard 3/8-inch mesh. The hypothetical intake would not have design elements or operational measures employed for the purpose of reducing impingement mortality or entrainment.

Besides other documents required with the submission of a permit application, the Rule requires development of a Comprehensive Demonstration Study (CDS), unless the applicant can demonstrate that the facility's intake cooling water flow is commensurate with a closed-cycle recirculating system (EPA Compliance Alternative #1). The CDS has several components, as outlined in Table 1-1. One component is a Proposal for Information Collection, which includes a sampling plan for any proposed field studies necessary to supplement existing information about the source waterbody, its fish and shellfish community, or current impingement mortality and entrainment rates. If it is determined that existing information might not accurately represent current impingement mortality and entrainment rates, the sampling plan will address proposed sampling for the Impingement Mortality and Entrainment (IM&E) Characterization Study, a required component of the CDS. This Impingement and Entrainment Sampling Plan fulfills this requirement for SONGS. Additional biological monitoring might be desirable depending on the specific compliance approach being used. The existing intake design and operation at SONGS differs from the calculation baseline and incorporates extensive fish protection technology. Therefore, additional studies will be conducted and integrated with existing information to estimate the effectiveness of the SONGS intake for reducing impingement mortality and entrainment and, by inference, the impingement and entrainment for the calculation baseline.

1.2 IM&E CHARACTERIZATION STUDY

The IM&E Characterization Study is an integral part of the CDS and the overall determination of BTA compliance. The IM&E Characterization Study provides information needed for development of all subsequent parts of the CDS, including the Design and Construction Technology Plan, the Technology Installation and Operation Plan, the Restoration Plan (optional), a site-specific determination of BTA (if justified), and ultimately the Verification Monitoring Plan (Table 1-1). The IM&E Characterization Study provides data on the rates of impingement mortality (and entrainment, when applicable) currently occurring at the plant, as well as a foundation for estimating the calculation baseline, needed for determining the levels of impingement mortality (and entrainment) reduction being achieved at the plant, presently and in the future. The Rule requires that the IM&E Characterization Study provide:

1. Taxonomic identifications of all life stages of fish, shellfish, and protected species in the vicinity of the CWIS and susceptible to impingement and entrainment;
2. A characterization of these species and life stages in terms of their abundance and their spatial and temporal distribution, sufficient to characterize the annual, seasonal and diel variations in impingement mortality and entrainment; and
3. Documentation of current impingement mortality and entrainment of these species and life stages.

In addition to these basic requirements, the IM&E Characterization Study may provide information necessary for SCE to choose the appropriate Rule compliance alternative, such as applying for a site-specific determination of BTA. To justify this alternative, the results of the IM&E Characterization Study are needed to evaluate the benefits of implementing technology, operational, or restoration measures, in terms of the numbers or biomass of fish and shellfish potentially saved or replaced by their implementation.

The EPA regulations allow impingement mortality and entrainment to be quantified either for all taxa or through the use of Representative Species (RS) as part of the compliance assessment. RS could be species most frequently observed in impingement and entrainment collections; species for which technology, operational modifications or restoration measures are directed; or species deemed to be most important because of their economic value (e.g., commercially or recreationally exploited species), value to the ecosystem (e.g., abundant prey species), or societal value (e.g., threatened or endangered species). RS also can be chosen as surrogates for other species not selected for detailed biological study. Since biological information necessary to complete analyses for the CDS are not available for all species, it is both more practical and more technically defensible to base all analyses on RS. In this sampling plan, we address the selection of RS that could be used for SONGS.

1.3 SAMPLING PLAN OBJECTIVES AND ORGANIZATION

This Impingement and Entrainment Sampling Plan has been prepared to meet the following objectives:

1. To identify and summarize existing data on the fish and shellfish community in the vicinity of the station's CWIS;
2. To identify and summarize existing data on fish and shellfish impingement and entrainment within the station's CWIS;
3. To evaluate the sufficiency of existing data to describe the current fish abundance and spatial and temporal distribution of fish in the vicinity of the station's CWIS, and the current rates of impingement and entrainment;
4. To make an initial selection of Representative Species; and
5. To prepare a work scope for monitoring and testing programs required to supplement existing information on impingement and entrainment at SONGS.

This sampling plan will be submitted to the CRWQCB as part of SCE's Proposal for Information Collection (PIC) for SONGS.

This sampling plan is organized to first present background information on the station, including the source waterbody (Section 2.1), the cooling water intake design and operation (Section 2.2), historical biological data (Section 2.3), and a discussion of the need for supplemental data for the IM&E Characterization Study (Section 2.4). Section 3 then describes the aquatic habitat and fish community in the vicinity of the station's CWIS, using available historical data. Sections 4 and 5 describe the recommended sampling scope for impingement monitoring and entrainment monitoring, respectively. These program work scopes describe the recommended sampling design, sampling gear and its deployment, sample processing procedures, collection of any required ancillary information, and data analysis. Section 6 describes a quality assurance program that will address data quality concerns.

Table 1-1 EPA's Comprehensive Demonstration Study (CDS) Requirements

Requirement
Proposal for Information Collection
A description of the selected combination of intake technologies, operational measures, and/or restoration measures being evaluated
A list and description of previous impingement/entrainment studies and/or studies on the physical or biological conditions in the vicinity of the CWIS and their relevance to the study
A summary of past or on-going consultations with federal, state, or tribal fish and wildlife agencies and a copy of written comments
A sampling plan for any new field studies proposed and documenting: • methods proposed and those used in similar studies in the same source water body • quality assurance/quality control procedures • description of the study area (including the zone of influence of the CWIS) • taxonomic identification of the sampled or evaluated biological assemblages (including all life stages of fish and shellfish)
Impingement Mortality and Entrainment Characterization Study
Taxonomic identification of the species and life stages of fish and shellfish in the vicinity of the CWIS that are most susceptible to impingement and entrainment
A characterization of the species most susceptible to impingement and entrainment including the abundance and temporal/spatial characteristics
If new information is needed to characterize IM&E, studies must be "of a sufficient number of years…to characterize annual, seasonal, and diel variations."
Samples used to support calculations of reduction of impingement mortality and entrainment; calculation of benefits must be conducted during periods of representative operational flows and flows must be documented
Documentation may include historical data that are representative of the current operation and biological conditions
Identification of threatened or endangered species protected under Federal, State or Tribal law
Design and Construction Technology Plan
Capacity and utilization rate of the facility and supporting documentation including: • average annual net generation of the facility over a 5 year period (if available) of representative operating conditions • total net capacity of the facility • calculations
Explanation of the technologies and operational measures being used or to be employed to meet § 125.94
A narrative description of the design and operation of all design construction technologies or operational measures necessary to meet national performance standards, and information that documents the efficacy for application with the species and life stages expected to be most susceptible to impingement and entrainment (include all design calculations, drawings, and estimates to support descriptions)
Calculations of the reduction of impingement mortality and entrainment of all life stages of fish and shellfish that would be achieved with the technologies or operational measures being adopted based on the Impingement Mortality and Entrainment Characterization Study described above (include all design calculations, drawings, and estimates to support descriptions)
Documents demonstrating that the location, design, construction and capacity of the CWIS technologies reflect BTA

Table 1.1 (continued)

Technology Installation and Operation Plan
A schedule for installation and maintenance of any new design and construction technologies
A list of operational parameters that will be monitored, including location and monitoring frequency
A list of activities to ensure the efficacy of the installed design and construction technologies and operational measures, to the degree practicable, and the implementation schedule
Schedule and methodology for assessing efficacy of the measures in achieving applicable performance standards, including an adaptive management plan for revisions if the standards are not being met
For pre-approved technologies (Compliance Alternative 4), documentation that appropriate site conditions exist for the technologies
Information to Support Restoration Measures
Explanation of why restoration measures would be more feasible, cost-effective, or environmentally desirable than by meeting performance standards or site-specific requirements wholly through use of design and construction technologies, and/or operational measures
A list and narrative description of the restoration measures in place or proposed for implementation, including species targeted
Quantification of the ecological benefits (production of fish and shellfish) from existing and/or proposed restoration measures, as well as a discussion of the nature and magnitude of uncertainty associated with the restoration measures and a discussion of the time frame for accrual of these benefits
Design calculations, drawings, and estimates documenting that the restoration measures, alone or in combination with technology or operational measures, will meet the requirements for production of fish and shellfish
An adaptive management plan to include: • a monitoring plan listing parameters that will be monitored, and describing the frequency of monitoring and criteria for determining success • list of activities to ensure efficacy of the restoration measures, the linkages between these activities and items in the monitoring plan, and an implementation schedule for the activities • a process for revising the plan if new information becomes available or if standards or site-specific requirements are not being met
A summary of past or on-going consultations with Federal, State, or Tribal fish and wildlife agencies and a copy of written comments
If requested, a peer review of items to be submitted as part of the restoration plan
A description of information to be included in a biannual status report
Information to Support Site-Specific Determination of BTA
Comprehensive Cost Evaluation – including detailed engineering cost estimates of the technological or operational modifications proposed in the Design and Construction Plan above
Valuation of the Monetized Benefits of Reducing Impingement and Entrainment (if the site-specific determination is being sought because the costs are significantly greater than the benefits) containing: • description of methodology used • the basis for any assumptions and quantitative estimates • analysis of the effects of significant sources of uncertainty on the results

Table 1.1 (continued)

Site-Specific Technology Plan containing: • a narrative description of the technologies, operational measures, and restoration measures that you have selected and information that demonstrates the efficacy of the technology for species in the vicinity of the CWIS and supporting design calculations, drawings, and estimates • engineering estimate of the efficacy of the technological or operational measures for reducing impingement and entrainment – include site-specific evaluation of the suitability of the technologies or operational measures for reducing IM&E based on representative studies and/or prototype studies and supporting design calculations, drawings, and estimates • documentation that demonstrates the technologies, operational measures, or restoration measures selected would satisfy §125.94 (establishment of BTA) Most of this information will be developed in the Design and Construction Technology Report
Verification Monitoring Plan – two years of monitoring to verify full-scale performance of technologies, operational measures, or restoration)
Plan must include: • frequency of monitoring • duration of monitoring • description of yearly status report to be submitted to the Director

2. BACKGROUND INFORMATION

This section provides a summary of available information on the San Onofre Nuclear Generating Station regarding its source waterbody (Southern California Bight), the design and operation of the facility, and previous biological studies at the station and in the source waterbody.

2.1 SOURCE WATERBODY

The San Onofre Nuclear Generating Station is located on the Southern California coastline between San Clemente and Oceanside, CA (Figure 2-1). The station is located south of Point Conception in the Southern California Bight. The coastal waters are influenced by a variety of oceanographic, biological, and meteorological components. Movements of the source water body are greatly affected by winds, tides, and currents.

The climate of southern California is Mediterranean with short, mild winters and warm, dry summers. Annual rainfall amounts average 46 cm, with most precipitation falling between November and April. The summer winds are characterized by sea breezes which combine with prevailing northwesterly winds to produced strong onshore winds. Southeast coastal winds are produced during late fall and winter.

There are two major oceanic currents that affect the Station: the California Current and the Davidson Current. The California Current flows southward along the California coastline to a point south of Tanner and Cortes Banks in which the current begins to flow easterly toward land and then turns into a northward flowing current known as the Southern California Countercurrent. The surface water circulation in the region is driven by a complex combination of predominant southerly flow, a northerly flowing countercurrent, coastal geometry, and bottom topography.

Coastal upwelling occurs when strong westerly or northwesterly winds driven by storms or pressure systems begin blowing and cause coastal water to move offshore which forces cooler water to rise from the bottom. Although occurrences have been infrequent, short periods of upwelling have been observed at SONGS as a result of strong west-northwest winds (SCE 1983).

2.2 INTAKE DESIGN AND OPERATION

SONGS consists of three units with a current, combined rated capacity of 2,174 MWe-net. Unit 1 began commercial operation in 1968 and stopped generating electricity in 1992. Unit 1 was a baseload plant and had an operating capacity of 436 MW. Unit 2 began low-power testing in 1982 and Unit 3 began start-up testing in 1982. Unit 2 became commercially operational in 1983, while Unit 3 became commercially operational in 1984. Units 2 and 3 each have an operating capacity of 1,087 MW. Units 2 and 3 utilize once-through cooling with a total design intake capacity of 2,390 MGD. The units generate power using pressurized water nuclear reactors. The reactors boil freshwater contained in a closed loop system with the resulting steam driving turbines which are then cooled in condensers by seawater. Seawater is brought into the condenser through a single intake, heat is absorbed, and the seawater is discharged into the ocean.

Units 2 and 3 each have a single offshore intake which extends 970.2 meters (3,183 feet) from shore and is set in water 9.8 meters (32 feet) deep. Each intake is equipped with a velocity cap which extends 5.5 meters (18 feet) above the ocean bottom. Each Unit has four circulating water pumps which bring cooling water to the plant, even when a Unit is not producing power. The pumps are shut down during scheduled maintenance when the cooling water system is dewatered (approximately every 18 months), and may be shut down for unscheduled maintenance activities. Debris and entrapped organisms are removed from the screenwells via bar racks and 3/8-inch mesh traveling screens. The trash bars have one inch opening and are operated using a drive mechanism to periodically remove coarse debris. The trash bars and traveling screens (7 at each unit) are angled to the inlet flow so as to guide fish to elevator baskets, which then return the fish to the ocean through a submerged fish return conduit.

A “heat treatment” procedure is used to control biofouling by mussels and barnacles at SONGS. During this procedure, two thirds of the normal discharge is diverted back through the condenser to heat the water in the screenwell to 105ºF. Water flow through the intake and discharge conduits are “swapped” by opening and closing valves in such a way that water temporarily enters through the discharge ports and discharges through the intake structure. In this way the intake conduit and velocity cap are treated with water up to 125° F.

2.3 HISTORICAL DATA

Southern California Edison conducted studies to assess entrainment and to evaluate the fish return system from 1978 through 1986. The Unit 1 §316(b) demonstration study report was submitted to the RWQCB in 1982 and demonstration study reports were submitted for Units 2 and 3 in 1988 (SCE 1998). Impingement studies have been conducted at SONGS Units 2 and 3 since 1983. Entrainment monitoring was conducted at SONGS Unit 1 in 1979 and 1980. Extensive studies were conducted to determine entrainment impacts at Units 2 and 3 from 1979 (preoperational period) through 1986. These studies used near-field sampling, rather than in-plant sampling, to estimate entrainment losses. These studies are available as a source of information for predicting the current levels of impingement and entrainment at SONGS and the fish species that would be involved.

2.3.1 Impingement Studies

Impingement sampling was conducted at SONGS weekly from 1983 to 1994, monthly from 1994 to 1998, and quarterly since 1999.

Fish enter the Station via an offshore cooling water intake which guides fish through the screenwell to the fish return system. Those specimens which do not enter the fish return system are impinged on traveling screens and are then collected in containers. Impingement sampling at SONGS was conducted once per quarter in 2003 (Jan-Mar; Apr-Jun; Jul-Sep; Oct-Dec). Prior to the 24-hour sampling period, all screens were run and cleared of all marine life and debris. Over the following 24 hours, screens were run as required for normal plant operation, however all marine life and debris was collected in large containers. At the end of the 24-hour period all screens were run a final time and any additional marine life and debris was added to the collection. Impinged fish were then separated from the debris, sorted by species, weighed, measured and examined for gender and evidence of disease.

Fish loss during heat treatments was also monitored and added to estimated total impingement losses. Fish which do not move into the fish return system during fish chase procedures, are killed by the elevated temperatures. Dead fish are removed on screens and are identified and sorted by species, counted, weighed, and sub-samples are measured and sexed.

Combined fish impingement at SONGS Units 2 and 3 from 1983 through 2003 has ranged from 3,672 kilograms in 1983 to 42,612 kilograms in 1995 (Figure 2-1). Species composition has been relatively consistent over the years and is represented by the 2003 survey.

The 2003 monitoring estimated annual impingement for Unit 2 was 995,396 fish representing 62 species (Table 2-1) (SCE 2003). Estimates were based on four quarterly impingement samples and nine heat treatment samples. Northern anchovy (*Engraulis mordax*) and queenfish (*Seriphus politus*) were the most abundant species representing over 88 and 8 percent of the total specimens collected, respectively. In addition, northern anchovy represented 61 percent of the total weight, while queenfish represented 19 percent of the total biomass.

The annual impingement for Unit 3 was considerably higher than Unit 2 in 2003, as an estimated 2,569,037 fish representing 60 species were impinged (Table 2-1) (SCE 2003). Northern anchovy was the most abundant species impinged, representing almost 89 percent of the total impingement and almost 61 percent of the biomass. Similar to Unit 2, queenfish were second in abundance, representing over 7 percent of the total collection and almost 18 percent of the total biomass.

Overall, SONGS impinged an estimated 3,564,433 fish in 2003 (Table 2-1). Northern anchovy and queenfish comprised 88 and 7 percent of the total 2003 impingement. Peak impingement occurred in July, August, and September mainly as a result of an increase in catch of northern anchovy (Table 2-2). Impingement counts also increased for queenfish, Pacific sardine (*Sardinops sagax*), and Pacific pompano (*Peprillus simillimus*) during this period. Overall, impingement totals during the July through September period accounted for more than 86 percent of the total yearly impingement at the Station.

Northern anchovy and queenfish have consistently made up the majority of fish numbers at SONGS, but in recent years Pacific sardines have become increasingly prevalent.

2.3.2 Entrainment Studies

Table 2-3 summarizes plankton studies completed at SONGS.

SCE conducted entrainment monitoring at SONGS Unit 1 from August 1979 through July 1980. Sampling was conducted monthly at the Unit 1 intake riser. Samples were pumped from within the offshore intake riser of the CWIS. Four replicate samples were collected during each of six periods over 24 hours.

Northern anchovy were the most commonly collected species, as they comprised 45.2% of the total entrainment in 1979-1980 (Table 2-4) (SCE 1983). Queenfish and white croaker (*Genyonemus lineatus*) were also abundant in entrainment samples, comprising 10.4 and 10.1 percent of the total respectively. Other species identified as target species were infrequently collected, as these species comprised only 1.9% of the total entrainment.

Peak entrainment occurred in spring from March through May and again in fall from September through October (Table 2-5). The largest number of northern anchovy (33.94×10^6) and white croaker (7.44×10^6) were entrained in March, while queenfish were most abundant in May (8.78×10^6). Several croaker species were listed as target species, including spotfin croaker (*Roncador stearnsii*), which was collected primarily in the month of September (2.04×10^6), black croaker (*Cheilotrema saturnum*), which were most abundant in summer months, and yellowfin croaker (*Umbrina roncador*), which were not collected in the 1979-1980 surveys. Several nontarget species were also occasionally collected in high numbers, including cheekspot goby (*Ilypnus gilberti*) in October (4.64×10^6), bay goby (*Lepidogobius lepidus*) in January (6.15×10^6), and California corbina (*Menticirrhus undulatus*) in September (3.10×10^6).

Extensive studies were conducted at SONGS by the Marine Review Committee (MRC) at the request of the California Coastal Commission (CCC). These studies included sampling designed to estimate losses due to entrainment at Units 2 and 3. (MRC 1989). Rather than directly measuring entrainment at the intake, these studies used a Before-After-Control-Impact (BACI) analysis to determine impacts on plankton by the SONGS intakes.

It was concluded that the effects detected were of relatively minor importance during the 1983-1986 monitoring period for the following reasons: (1) no general large-scale reduction of plankton abundance was detected; (2) although there were suggestions of relatively uniform patterns of change within some subsets of the ichthyoplankton and macrozooplankton, there was no evidence of an overall uniform pattern of change in the plankton community; (3) in many cases where significant changes were detected, plausible alternative explanations for those changes could be postulated; and (4) for the ichthyoplankton, significant test results tended to reflect changes in the more numerous younger larvae, which are less important than the older larvae in terms of adult equivalents (MEC 1987).

2.3.3 Fish Return System Studies

SONGS utilizes a fish return system (FRS) which is normally operated to return accumulated fish to the ocean at least twice a day by station operators. The system uses a series of vanes and louvers to create a pressure differential and velocity changes which are detected by fish, causing them to swim along the louvers and into a quiet bypass area (Schuler and Larson 1975). The bypass area measures 4.9 x 4 m and is equipped with a watertight elevator basket. Fish congregating in the bypass area are transported via an elevator basket to a sluiceway which returns the fish back to the ocean.

Studies of the FRS were conducted from 1984 through 1994 and again in 1999. These studies were conducted at SONGS to evaluate the diversion effectiveness of the fish return system and the survival of fish following transport through the return system to the waterbody (SCE 1988; Love et al. 1989; SCE 2003). The fish returned back to the ocean were identified and counted as they were lifted in the elevator basket. Biomass and numbers of species too numerous to make visual counts were estimated by sub-sampling the elevator with nets. Efficiency ratings were estimated from these studies based on the number of fish returned to the ocean alive compared to the number of fish impinged during normal operation. These ratings are a measure of the reduction in impingement mortality achieved by the FRS. Overall efficiency ratings across all species have varied among study years and between units, with the highest rating of 96.5% for Unit 2 in 1984 and a low of 36.6% for Unit 3 in 1990. The 1999 results indicate 72 percent efficiency for Unit 2 and 68 percent for Unit 3 (SCE 2003). The efficiency of the fish return system likely depends both on environmental and water quality conditions, and on species specific survival and behavior.

Return rates for the most abundant species, northern anchovy and queenfish, were high with 99.3 and 87.7 percent efficiency, respectively (Love et al. 1989). In addition, the system was efficient for strong swimming species and many commercially and sport important species such as jacksmelt (*Atherinopsis californiensis*), salema (*Xenistius californiensis*), topsmelt (*Atherinops affinis*), kelp bass (*Paralabrax clathratus*), yellowfin croaker, California corbina (*Menticirrhus undulatus*), and California halibut (*Paralichthys californicus*). The system was not as effective in diverting weak swimming species such as plainfin midshipman (*Porichthys notatus*), pipefish (*Syngnathus* spp.), and giant kelpfish (*Heterostichus rostratus*).

Survival studies were conducted in 1984 and 1985 to evaluate fish survival following passage through the fish return system. Ninety-six hour in-situ survivorship studies were conducted by holding fish in holding nets at the end of the return system. Survival rates for most species were high (>90 percent), with northern anchovy, salema, and yellowfin croaker exhibiting very little mortality (Love et al. 1989). Survival of queenfish was not as favorable, as 31.6 and 54.1 percent of the specimens survived the 96-hour holding experiments for Units 2 and 3 respectively. In addition, survival of white croaker was 49.5 percent and 25 percent at Units 2 and 3, respectively, and no slough anchovies (*Anchoa delicatissima*) survived the experiment.

Uncertainty in the estimates of FRS efficiencies was high for smaller size categories of fish (e.g., less than about 50 mm) in the prior studies since the sampling design did not attempt to account for very small or larval fish that are assumed to pass through the station (entrained). That is, the ratio of fish returned to fish impinged may have underestimated FRS efficiency in returning small juvenile and larval fish that passed through sampling nets. Return of larvae and entrainable-sized juveniles by the FRS has been qualitatively observed in these prior studies. Therefore, the FRS undoubtedly has some, as yet unquantified, effectiveness for reducing entrainment, as well as impingement, relative to intake systems without this fish protection technology.

2.3.4 Fish Chase Operations

Prior to heat treatments, a fish chase procedure is used to guide fish out of the circulating water system and into the fish return system. The fish chase procedure is used to minimize mortality to fish residing in the circulating water system intake or screenwell areas, which would otherwise die during heat treatments.

Many fish will reside in the habitats created around the gate slots and other structures of the cooling water system. These fish are guided toward the fish return by manipulating cross-over gates in the screenwell which slowly warms the water and creates eddy currents to dislodge fish residing in low flow habitats. A target temperature of 83ºF is typically used during fish chase operations, however higher temperatures are sometimes needed to dislodge warm water species such as yellowfin croaker, sargo (*Anisotremus davidsonii*), and zebra perch (*Hermosilla azurea*) (SCE 2003). The process dislodges the fish and causes them to move toward the fish return system. The operation is monitored by fisheries biologists to ensure fish are not being overly stressed. The number of fish impinged during heat treatment operations and the number of fish released back to the ocean during fish chase procedures is recorded along with data on fish condition, species composition, operational status, and water temperatures.

Overall in 2003, fish chase operations successfully released over 46% of all fish by number and over 56% of the biomass of fish that would have otherwise been killed during the heat treatment (SCE 2003). A total of 9 fish chase operations were performed for Unit 2 and 7 for Unit 3 which resulted in the release of 25,633 and 50,312 fish back into the ocean, respectively. Fish were released in good condition, as maximum water temperatures ranged from 80 to 87ºF and biologists monitoring the procedure terminated the temperature rise when indications of fish stress were observed.

Analysis of commonly impinged species revealed limited effectiveness of fish chase procedures for several species. Queenfish, the second most frequently impinged species exhibited a 23 percent release as a result of fish chase operations, and several species including shiner perch (*Cymatogaster aggregata*) and deep body anchovy (*Anchoa compressa*) exhibited a zero percent return. Fish chase operations were 53 percent effective in returning northern anchovy, the most frequently impinged species, back to the ocean prior to heat treatments.

2.3.5 Velocity Cap

SONGS utilizes an intake velocity cap on both Units 2 and 3 intakes as a means of reducing fish entrapment. The effectiveness of a velocity cap is dependent on the ability of species to avoid the horizontal flow created by a velocity cap. Early studies on the effectiveness of velocity caps indicated a 95% reduction in annual fish entrapment at the El Segundo Generating Station in 1956 and 1957 (Weight 1958). However, fish entrapment is potentially density-dependent, which was an aspect not considered in the Weight study. Laboratory studies indicate 85 to 90 percent reductions in anchovy entrapment may be expected using a velocity cap (Schuler and Larson 1975).

Velocity cap studies performed at Ormond Beach Generating Station (OBGS) and Huntington Beach Generating Station (HBGS) in 1979 and 1980 indicated an overall reduction in fish entrapment as a result of a velocity cap, with generally higher effectiveness during daylight hours (Thomas et al. 1980a). Entrapment rates for queenfish were higher from samples collected with a velocity cap during night sampling at HBGS (1979) and OBGS (1980). The velocity cap was effective in reducing entrapment of northern anchovy, the most frequently impinged species at SONGS, in the studies conducted at HBGS in 1979 and 1980. In addition, laboratory studies indicate anchovy were better adapted to resist the horizontal flow of a velocity cap than the vertical downward flow of an uncapped intake (Schuler and Larson 1975).

The use of velocity caps as a technology for reducing impingement is widely accepted. Although it is impractical to perform site-specific studies at SONGS that would provide additional estimates of velocity cap effectiveness, substantial information is available from laboratory design studies and prior field studies elsewhere. These data can be used to estimate a reasonable range of effectiveness of the SONGS velocity cap for reducing impingement to be incorporated into baseline impingement estimates. Possible day-night differences in velocity cap efficiencies have been suggested in the literature, but it is unclear whether measured differences in entrapment are caused by diel changes in fish densities near the intakes or changes in velocity cap effectiveness, or both.

2.4 Sufficiency of Existing Information for IM&E Characterization Study

As described in Section 1.2, the IM&E Characterization Study requires biological data on the following:

1. Identification of fish and shellfish life stages and species in the vicinity of the CWIS and susceptible to impingement and entrainment;
2. Their abundance and spatial/temporal distribution, sufficient to characterize the annual, seasonal and diel variations in impingement mortality and entrainment; and
3. Documentation of current impingement mortality and entrainment of these species and life stages.

USEPA criteria for using historical data are that the data must: (1) reflect current conditions and, (2) have been collected using appropriate QA/QC measures.

As discussed above and in Section 3, there is information currently available on the fish community in the vicinity of the SONGS that might satisfy the first two requirements. However, there are no current data on entrainment at SONGS, since the most recent monitoring studies were conducted over 19 years ago. In addition, sampling frequent enough to account for short-term temporal variations in impingement has not been conducted since quarterly monitoring began in 1999.

In terms of the fish community and its relationship to impingement and entrainment at SONGS (the first two items above), sustained trends in annual abundance resulting from changes in predominant currents and climate trends such as El Niño may cause some species or life stages to become more or less abundant in the vicinity of the intake.

The third item listed above as information required for the IM&E Characterization Study, i.e., documentation of current impingement mortality and entrainment, would not be satisfied by using available data. Therefore, the remaining sections of this sampling plan are devoted to describing the aquatic habitat and fish community for the purpose of a preliminary selection of representative species, and outlining a recommended sampling scope for monitoring impingement and entrainment.

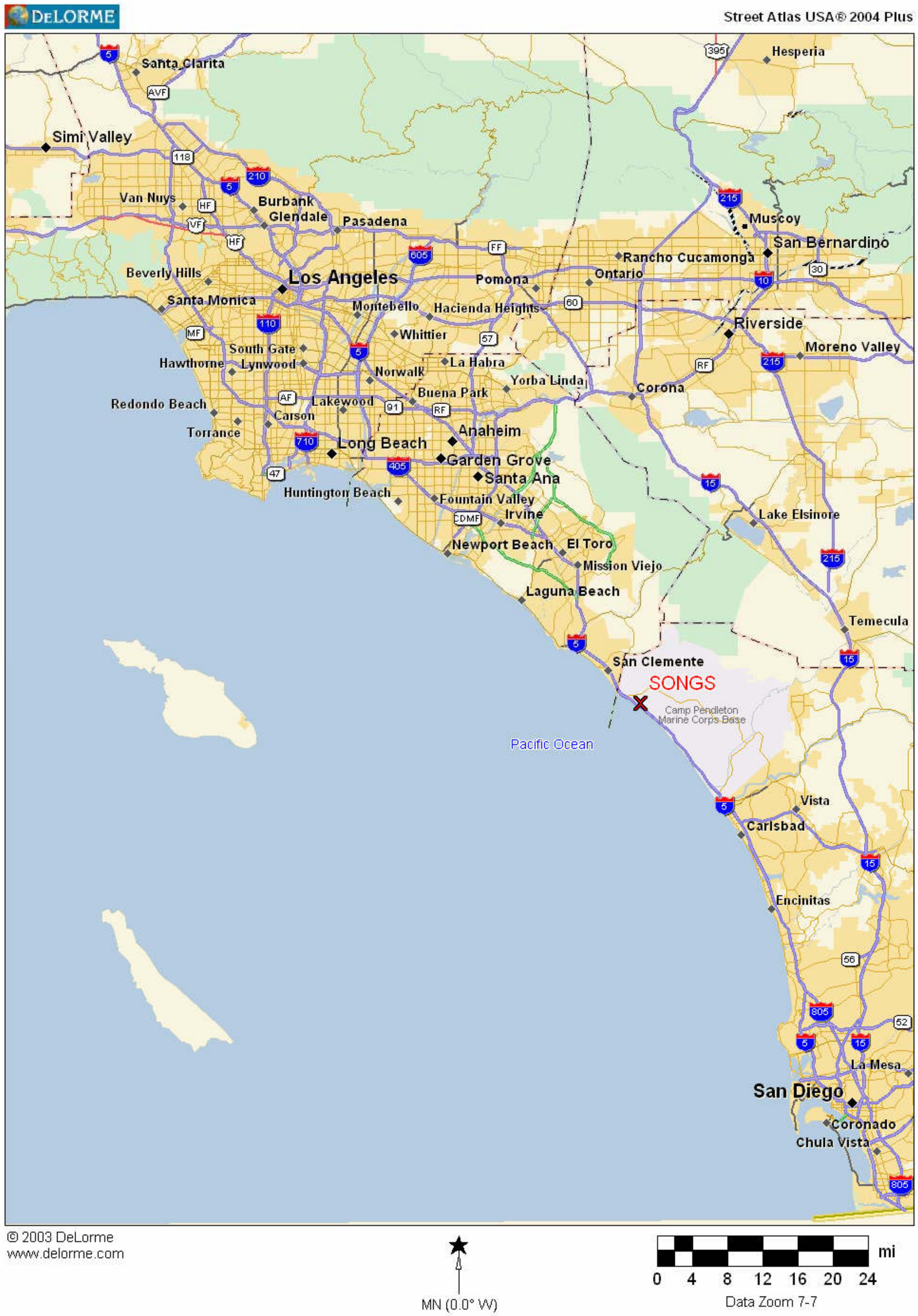

Figure 2-1. Location of the San Onofre Nuclear Generating Station.

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Figure 2-2. Aerial view of San Onofre Nuclear Generating Station.

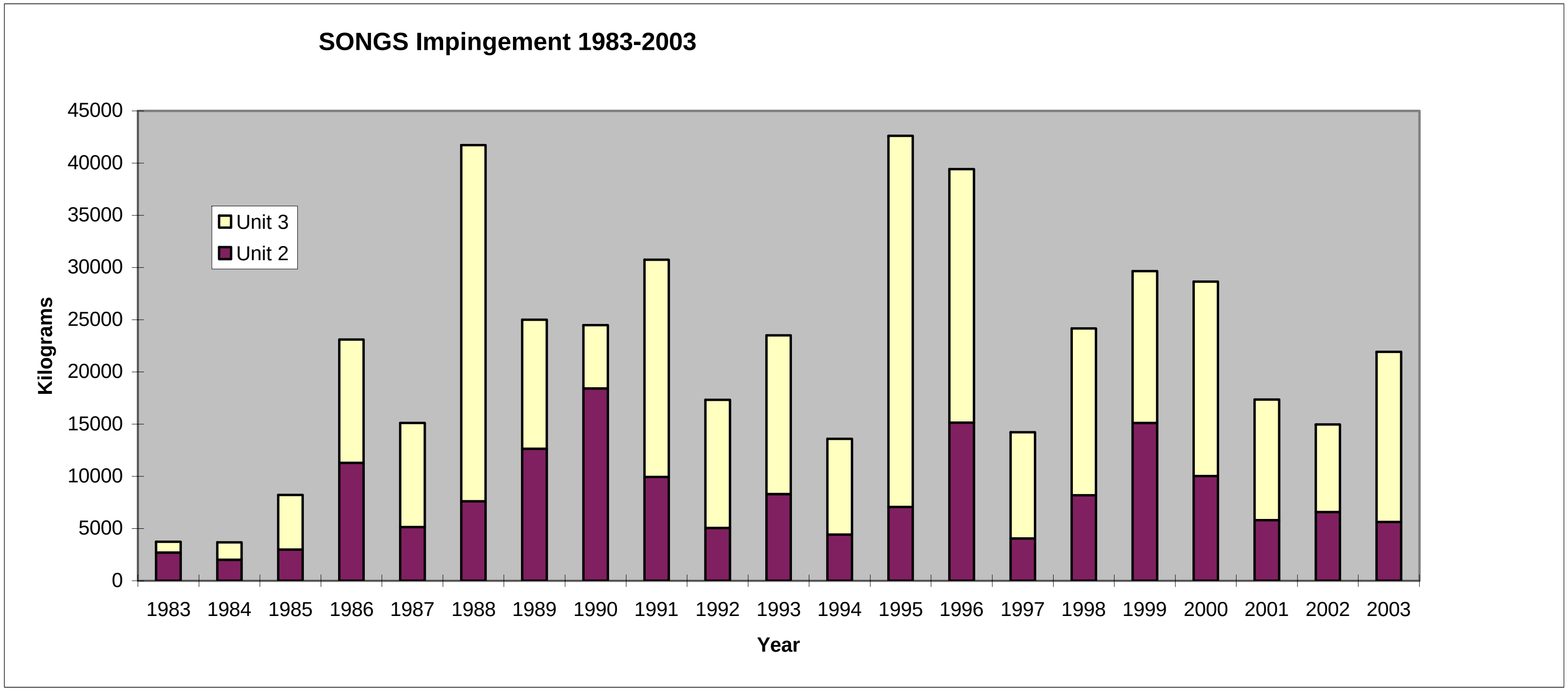

Figure 2-3. SONGS Impingement 1983-2003.

Table 2-1 Estimated Number of Fish Impinged at San Onofre Nuclear Generating Station, 2003

Common Name	Unit 2 Abundance	Unit 3 Abundance	Total Impingement	% of Total	Biomass (kg)
Northern Anchovy	883,575	2,281,516	3,165,091	88.80%	13,347.78
Queenfish	81,746	191,879	273,625	7.68%	3,999.22
Pacific Sardine	12,742	50,597	63,339	1.78%	2,328.69
Pacific Pompano	4,419	22,162	26,581	0.75%	566.00
Jacksmelt	2,077	5,672	7,749	0.22%	341.62
White Seaperch	372	3,624	3,996	0.11%	27.62
Walleye Surfperch	1,551	1,877	3,428	0.10%	48.07
Shiner Perch	1,401	1,836	3,237	0.09%	22.62
White Croaker	727	2,026	2,753	0.08%	57.62
Bocaccio	762	1,661	2,423	0.07%	7.78
Jack Mackerel	830	492	1,322	0.04%	66.27
Salema	1,004	266	1,270	0.04%	77.38
Sargo	326	864	1,190	0.03%	324.59
Yellowfin Croaker	526	416	942	0.03%	233.60
Specklefin Midshipman	73	823	896	0.03%	100.12
Black Perch	199	607	806	0.02%	11.37
California Grunion	372	369	741	0.02%	11.97
Topsmelt	603	119	722	0.02%	34.20
Cabezon	480	158	638	0.02%	5.77
Deep Body Anchovy	56	488	544	0.02%	6.06
Others	1,555	1,585	3,140	0.09%	304.65
Impingement Totals	**995,396**	**2,569,037**	**3,564,433**	**100.00%**	**21,922.98**

Table 2-2 Estimated Monthly Impingement Based on Quarterly Sampling at San Onofre Nuclear Generating Station, 2003

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Northern Anchovy	4,403	8,845	15,166	57,568	61,618	62,747	1,104,021	1,106,421	708,691	23,193	8,284	4,134	3,165,091
Queenfish	7,507	16,571	27,937	5,274	6,425	6,639	32,110	33,264	20,751	24,557	44,624	47,966	273,625
Pacific Sardine	1,729	3,616	5,962	153	156	171	14,385	14,390	11,932	5,379	2,678	2,788	63,339
Pacific Pompano	4	-	57	2	6	4	9,462	9,463	7,538	24	16	5	26,581
Jacksmelt	786	475	1,189	704	223	194	183	125	49	1,016	1,431	1,374	7,749
White Seaperch	6	-	6	1,232	1,298	1,261	58	55	67	9	2	2	3,996
Walleye Surfperch	59	-	16	706	716	748	380	324	298	20	48	113	3,428
Shiner Perch	42	-	5	543	660	611	500	463	104	151	129	29	3,237
White Croaker	40	56	111	327	374	383	339	604	347	50	51	71	2,753
Bocaccio	-	-	-	780	806	789	30	12	6	-	-	-	2,423
Jack Mackerel	95	56	70	2	1	6	131	126	160	89	350	236	1,322
Salema	31	-	2	5	5	33	41	116	302	558	79	98	1,270
Sargo	2	-	2	-	-	89	241	648	154	42	10	2	1,190
Yellowfin Croaker	8	-	4	4	-	45	119	166	167	361	68	-	942
Specklefin Midshipman	20	56	93	90	93	94	158	159	127	3	3	-	896
Black Perch	-	-	6	212	262	267	17	6	22	12	2	-	806
California Grunion	63	56	62	150	161	153	-	-	1	31	33	31	741
Topsmelt	53	-	1	-	-	83	164	126	31	64	164	36	722
Cabezon	-	-	1	153	193	261	20	5	3	1	-	1	638
Deep Body Anchovy	55	93	156	-	-	-	-	-	-	35	105	100	544
Others	120	93	192	230	295	405	344	331	288	137	397	308	3,140
Total	**15,023**	**29,917**	**51,038**	**68,135**	**73,292**	**74,983**	**1,162,703**	**1,166,804**	**751,038**	**55,732**	**58,474**	**57,294**	**3,564,433**

Table 2-3 Historical Summary of Plankton Studies at SONGS

STUDY	Date	Description	Frequency
SONGS Unit 1 316(b) entrainment studies	8/79-7/80	Pumped from intake	Monthly; 6 samples, 4 reps each; over 24-hr period
SONGS 2&3 Pre-Operational	8/79-11/81	Manta, bongo and Auriga nets; 400 m3; As close as possible to intakes and at Control	Approx. weekly during peak months. 38 sample days
SONGS 2&3 Interim Period	3/82-6/83	Manta, bongo and Auriga nets; 400 m3; As close as possible to intakes and at Control	Monthly during peak months. 5 sample days
SONGS 2&3 Operational Period	7/83-9/86	Manta, bongo and Auriga nets; 400 m3; As close as possible to intakes and at Control	Monthly during peak months. 27 sample days.
SONGS 2&3 Intake Loss Surveys	10/85-1/86	Manta, bongo and Auriga nets; 400 m3; As close as possible to intakes and at Control	Tri-weekly; 6 survey days

Table 2-4 Estimated Number of Fish Collected in Entrainment Samples at San Onofre Nuclear Generating Station, 1979-1980. Estimated Daily Entrainment (No. x 10^6) (SCE 1983)

Common Name	Daily Entrainment	% of Total
Northern Anchovy	6.5	45.2%
White Croaker	1.46	10.1%
Queenfish	1.5	10.4%
Pacific Butterfish	0.01	0.1%
Kelp Bass	0.05	0.3%
Barred Sand Bass	<0.01	<0.1
Sargo	0.01	0.1%
Spotfin Croaker	0.17	1.2%
Bocaccio	-	-
Black Croaker	0.02	0.1%
Yellowfin Croaker	-	-
Cheekspot Goby	0.77	5.4%
Bay Goby	0.61	4.2%
Blenny	0.58	4.0%
California Corbina	0.33	2.3%
Kelpfish	0.23	1.6%
Unidentified Larvae	1.17	8.1%
Others	0.97	6.7%
Totals	14.38	100.0%

Table 2-5 Estimated Fish Entrainment At San Onofre Nuclear Generating Station, 1979-1980. Daily Entrainment (No. X 10^6) From Monthly Samples (SCE 1983)

Common Name	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Northern Anchovy	2.30	5.00	5.53	0.09	0.81	1.20	4.49	33.94	14.14	9.64	0.35	6.50
White Croaker	0.05	0.06	0.12	-	2.33	0.67	1.46	7.44	2.85	2.28	0.07	1.46
Queenfish	0.65	0.96	0.12	-	-	-	-	1.37	4.70	8.78	1.24	1.50
Pacific Butterfish	-	-	-	-	-	-	-	0.07	0.04	-	-	0.01
Kelp Bass	0.28	0.17	0.09	-	-	-	-	0.01	-	-	-	0.05
Barred Sand Bass	-	<0.01	-	-	-	-	-	-	-	-	-	<0.01
Sargo	0.08	0.01	-	-	-	-	-	-	-	-	-	0.01
Spotfin Croaker	-	2.04	-	-	-	-	-	-	-	-	-	0.17
Bocaccio	-	-	-	-	-	-	-	-	-	-	-	-
Black Croaker	0.04	0.07	-	-	-	-	-	0.02	0.01	0.05	0.01	0.02
Yellowfin Croaker	-	-	-	-	-	-	-	-	-	-	-	-
Cheekspot Goby	0.07	0.92	4.64	0.02	0.05	2.64	0.36	0.05	0.19	0.12	0.11	0.77
Bay Goby	0.02	0.07	0.09	-	0.03	6.15	0.67	0.14	0.01	0.04	0.03	0.61
Blenny	1.94	0.81	0.15	0.05	0.05	0.02	0.01	0.07	0.14	1.16	1.02	0.58
California Corbina	0.85	3.10	-	-	-	-	-	-	-	-	-	0.33
Kelpfish	0.06	0.26	0.50	0.01	0.57	0.63	0.52	0.01	0.04	0.10	0.05	0.23
Unidentified Larvae	1.70	2.77	0.35	0.03	0.43	0.40	3.86	3.27	0.53	0.68	0.19	0.08
Others	1.46	2.87	0.84	0.10	0.34	2.35	1.05	0.47	0.97	0.29	0.15	2.06
Totals	9.50	19.11	12.43	0.30	4.61	14.06	12.42	46.86	23.62	23.14	3.22	14.38

3. FISH COMMUNITY

This section describes the aquatic habitat and the fish community in the vicinity of the San Onofre Nuclear Generating Station and proposes representative species for detailed study.

3.1 AQUATIC HABITAT

SONGS withdraws its cooling water from the Southern California Bight, an open embayment of the Pacific Ocean that extends from Point Conception, California to the north, southward to Cabo Colnett, Baja California. The water in the vicinity of SONGS is dominated by the California Current that flows southeast along the coast and changes to a Southern California counter currents which sometimes exhibits upwelling. The temperature of the water follows a normal seasonal cycle with a summer high water temperature around 68°F in August and a winter low water temperature around 57°F (SAIC 1994). There can be some changes to the normal seasonal cycles from upwelling of colder waters in localized events. This generally happens when winds cause surface currents that flow offshore and result in a breakdown of thermal stratification bringing the colder water to surface.

The nearshore oceanic habitats in the vicinity of the Station may be divided into intertidal habitat, subtidal habitat and kelp beds for purposes of discussion.

3.1.1 Intertidal

The wave-swept, sandy beaches in the vicinity of the plant provide one of the most hostile of marine environments being subject to intense wave-induced energies, exposure to air and sun during low tides, and the constant reworking and major seasonal movements of the substrate. In addition, periodic beach replenishment activities can lead to burial of existing habitats. As a result, these habitats have a relatively sparse and patchily-distributed aquatic community. Typical year-round inhabitants include the air-breathing pill bug (*Alloniscus perconvexus*), an isopod (*Tylos punctatus*), the beach hopper (*Orchestoidea califo*rniana), the mole crab (*Emerita analoga*), an opossum shrimp (*Archaemysis maculata*), polychaete worm (*Euzonus mucronata*), the bean clam (*Donax gouldi*), and the Pismo clam (*Tivela stultorum*). In addition, California grunion (*Leuesthes tenu*is) utilize the beach areas as spawning habitat during the warmer part of the year.

3.1.2 Subtidal Sand

The majority of habitat in the vicinity of SONGS is comprised of soft subtidal sediments (coarse to fine sand) with few hard substrates. The shallow nearshore benthic environment is subject to frequent disturbance due to wave action. The frequency of this disturbance declines further offshore as the water deepens. In addition, seasonal movement of beach sand inshore during summer months and offshore during the winter can result in burial of existing habitat and associated fauna. The unstable nature of this habitat leads to a heterogeneous assemblage of organisms, both spatially and temporally, which occupy this type of habitat.

Common benthic macroinvertebrate species which are found in this habitat include the polychaete worm (*Apoprionospio pygmaeus*), the proboscis worm (*Carinoma mutabilis*), a sea spider (*Callipallene californiensis*), and crustaceans such as *Megaluropus* sp. and *Leptocuma forsmani*. Overall, poychaete worms are the most abundant and common group in this habitat, followed by amphipods and other arthropods. Fish which can be common on this habitat include flatfish, such as the speckled sanddab (*Citharichthys stigmaeus*), the hornyhead turbot (*Pleuronichthys verticalis*), and the California halibut (*Paralichthys californicus*). In the water above this habitat, various planktonic invertebrates, such as the calanoid copepod, *Acartia tonsa*, and pelagic fishes, such as the northern anchovy (*Engraulis mordax*), the deepbody anchovy (*Anchoa compressa*), and the topsmelt (*Atherinops affinis*), can all be common.

3.1.3 Kelp Beds

The kelp beds are one of the most conspicuous habitats visible along the southern coast of California. These kelp beds form in areas were suitable rocky substrate is available in the appropriate depths of water. In the vicinity of SONGS there are three recognized distinct kelp stands. The nearest bed is the San Onofre Kelp Bed (SOK) which is about 0.5 km south of the Units 2 and 3 discharge diffusers. The second is the San Mateo Kelp Bed (SMK) which is about 4.5 km north and the farthest is the Barn Kelp Bed (BK). The area extent of each of these kelp stands varies both seasonally with normal growth patterns of the kelp and across the years as a result of varying meteorological conditions and the amount of rock substrate exposed from the sand bottom.

These kelp beds consist of dense stands of giant kelp (*Macrocystis pyrifera*) and related algae which serve as habitat for a variety of plant and animal species. Mature giant kelp plants can reach a length of 50-150 ft extending upwards from a root-like holdfast which attaches the plant to the rocky substrate. Many of the individual plants often grow together forming an underwater “forest” which is the kelp bed. Each plant consists of one or more fronds which form a dense canopy that can shade the entire bed. Beneath the giant kelp canopy resides an understory of smaller macroalgal species such as *Eisenia aborea*, *Egregia laevigata*, *Laminaria farlowii*, and *Cystoseira osmundacea*. The density of this subcanopy component also varies both seasonally and across the years along with the giant kelp. Finally, nearest to the substrate is a turf component consisting of a variety of smaller red and brown algae such as *Rhodymenia californica*.

The combination of the three components of the vegetative community, together with the rocky substrate, provide habitat for a variety of invertebrate and vertebrate species.

Common invertebrates within the turf component include a sea fan (*Muricea californica*), tubeworms (e.g., *Diopatra ornata*), tunicates (e.g., *Styela montereyensis*), and whelks (e.g., *Kelletia kelletii*), along with a variety of smaller species (bryozoans, sponges, tunicates, hydrozoans, etc.). Invertebrate species of commercial and recreational value that utilize kelp bed habitat include, abalone, sea urchins, and spiny lobster. The kelp beds also serve as important habitat for a variety of fish species. Common fish inhabitants include the kelp bass (*Paralabrax clathratus*), the barred sand bass (*Paralabrax nebulifer*), the black perch (*Embiotoca jacksoni*), the kelp surfperch (*Brachyistius frenatus*), the white seaperch (*Phanerodon furcatus*), and the California sheephead (*Semicossyphus pulcher*). Much of the recreational fishing in the nearshore waters occurs in and immediately adjacent to kelp beds similar to those described herein.

3.2 COMMUNITY COMPOSITION

The fish community in the vicinity of the SONGS intake can be characterized from a number of fish surveys that were conducted both before and after Units 2 and 3 began operation in the early 1980's, as well as from impingement sampling at the SONGS intake. These surveys cumulatively have documented the occurrence of at least 40 kelp related species, 66 pelagic or midwater species (live in the water column), and 68 benthic species (live on or near sandy bottom) (MRC 1989). The majority of the kelp-related species are also associated with reefs in general.

Of the 10 most common pelagic species, only the northern anchovy is a major commercial resource. Pacific mackerel, Pacific barracuda and the white croaker are sport fish (MRC 1989). Most of the abundant pelagic fish are typically small schooling species that are important as food for larger sport and commercial species. The most abundant species of midwater fish are northern anchovy, young queenfish, young white croaker, and three species of silversides. Queenfish and white croaker are common at all depths in the nearshore water column. However, larger pelagic predatory fish, such as Pacific mackerel and jack mackerel, become relatively common only in the deeper water.

Bottom fish in the vicinity of SONGS include the larger bottom-oriented individuals of white croaker and queenfish, as well as species with sport or commercial value such as longfin sanddab, speckled sanddab, hornyhead turbot and halibut (MRC 1989).

As a result of habitat preferences, ability to avoid the cooling water intake, other life history characteristics, and the design of the SONGS intake, only a fraction of the species comprising the community of the Southern California Bight in the SONGS' vicinity is susceptible to impingement and entrainment. Northern anchovy and queenfish are by far the most abundant species impinged at SONGS. For example, these two species comprised over 96 percent of the 60 species of fish impinged at SONGS during 2003 (Table 2-1). Most species were impinged in low numbers—four species accounting for more than 99 percent of the fish impinged. Entrainment sampling at Unit 1 during 1979-80 indicated that Northern anchovy, together with queenfish and white croaker, comprised about 66 percent of total fish entrained at SONGS, and a total of 15 species accounted for at least 85 percent of the fish entrained.

3.2.1 Protected Species

Federally protected fish and shellfish species that may occur near SONGS include the Southern California steelhead (*Onchorhynchus mykiss*), *tidewater goby (Eucyclogobius newberryi)*, and white abalone (*Haliotis sorenseni).* California state protected species that may occur near SONGS include giant sea bass (*Sterolepis gigas*), broomtail grouper (*Mycteroperca xenarcha*), gulf grouper (*Mycteroperca jordan*i) and garibaldi (*Hypsypops rubicundus*). There are also several species that are not protected but are of special concern including cabezon (*Scorpaenichthys marmoratus*) and bocaccio (*Sebastes paucispinis*) (SCE 2003).

Protected fish species are infrequently impinged at SONGS. For example, no protected fish species were collected in impingement monitoring during 2003, although a total of 15 giant sea bass were entrapped and returned to the ocean by the FRS. Two species categorized by the State as of special concern, cabezon and bocaccio, are impinged in low numbers at SONGS (e.g., Table 2-1).

Of the federally protected species, the tidewater goby, Southern California steelhead, and white abalone have never been observed near SONGS. The tidewater goby is normally found in brackish water of streams but may come into coastal water after heavy rain (SCE 2004). The Southern California steelhead is thought to be in San Mateo Creek which is just north of SONGS (SCE 2004). White abalone adults live on the bottom and in kelp beds and reefs in deep waters and thus are not generally vulnerable to impingement at the SONGS intake, although as larvae they may be entrained (SCE 2004).

3.3 REPRESENTATIVE INDICATOR SPECIES

Proposed additional entrainment and impingement monitoring (Sections 4 and 5) will identify all fish and selected important shellfish to the lowest practical taxonomic level. However, for several reasons it is beneficial to focus the proposed FRS studies and subsequent assessments of compliance on a subset of representative species. The following are proposed as representative indicator species for the SONGS compliance assessment:

Common Name	Scientific Name
Northern anchovy	*Engraulis mordax*
Queenfish	*Seriphus politus*
White croaker	*Genyonemus lineatus*
Pacific sardine	*Sardinops sagax*
Kelp/Sand Bass	*Paralabrax spp.*
Spiny Lobster	*Panulirus interruptus*

These species account for approximately 98% of impinged fish and 84% of historical entrainment, are representative of a range of FRS effectiveness observed in prior studies, include both pelagic and bottom oriented species, and have available life history information needed for calculating Lost Yield and Production Foregone. These are two measures of equivalent loss that are useful for expressing entrainment and impingement reductions on an equivalent basis and essential for estimating economic benefits from existing or proposed fish protection measures. At present, few, if any, of the other species occurring in impingement and entrainment at SONGS have well described age and growth characteristics adequate for equivalent loss estimates

3.3.1 Northern Anchovy

Northern anchovy is one of four species of Engraulidae (anchovies) reported from the California coast. The northern anchovy is an important commercial species and one of the more abundant fish occurring near SONGS. Northern anchovy are harvested for human consumption, live or dead bait, and other commercial uses, and have become especially important to commercial fisheries with the decline of the Pacific sardine populations (McCrae 1994). Northern anchovy are also important for prey for many predator fish, sea birds, and marine mammals.

Northern anchovy are frequently the dominant species impinged at SONGS, for example, comprising over 88 percent of the estimated impingement during 2003 (Table 2-1). Northern anchovy were also the most abundant fish species entrained at SONGS during the 1979 studies (Table 2-3). Northern anchovy abundance along the southern California coast may fluctuate widely from year to year depending on climatological conditions, including El Niño events.

The northern anchovy is a broadcast spawner. Females can lay upwards of 30,000 eggs a year over multiple times. In southern California, northern anchovy spawn throughout the year with peaks from winter to spring (Love 1996). Eggs and larvae are planktonic, larvae begin schooling at 11-12 mm and transition to juveniles at 35-40 mm at about 70 days post-hatch (Kucas 1986). Many of the anchovies will mature before the year is up but the rest will mature by their second year of life (Kucas 1986). They can live up to 7 years with a size near 9 inches.

Northern Anchovies will usually migrate offshore during the winter and come back inshore in the spring. These movements may alter their seasonal susceptibility to impingement at SONGS with low impingement during late fall and winter than at other times of year.

3.3.2 Queenfish

Queenfish are members of the croaker family (Sciaenidae) and are commonly caught by pier anglers. In addition, queenfish are common in coastal trawl surveys in the Southern California Bight (MBC 1995a). Queenfish were the most abundant species collected in 6.1 meter isobath trawl surveys in Santa Monica Bay between 1982 and 1984 (MBC 1997). Queenfish are found from Baja California to Yaquina Bay, Oregon, although they are rare north of Monterey, California. They are a schooling species which inhabit shallow water near pilings and sandy bottoms in summer (Love 1991). Queenfish typically inhabit depths from 4 to 27 feet, but can often be found at depths up to 180 feet. They congregate near inshore areas during the day and move offshore at night to feed on crustaceans and plankton (Herbinson et al. 2001).

Queenfish spawn from March to April with females maturing at 100-105 mm SL (DeMartini and Fountain 1981). The eggs are free floating. Larval queenfish less than an inch begin appearing in late summer and fall at depths of 20 to 30 feet. Immature queenfish continue moving shoreward until reaching the surf zone at 1 to 3 inches in length.

Queenfish were the second most abundant species collected in impingement samples in 2003 and entrainment samples collected in 1979-1980 (SCE 2003; SCE 1983). Queenfish impingement abundance at SONGS has fluctuated, and, as in 1998 (SCE 1998), they are sometimes the most numerous species impinged. Queenfish abundance fluctuates in the Southern California Bight as a result of El Niño. Queenfish populations exhibited sharp declines during several strong El Niño periods including the following years: 1982-1983, 1986-1987, and 1997-1998 (Herbinson et al. 2001).

3.3.3 Pacific Sardine

Pacific sardine is a member of the family Clupeidae (herrings). Until the population declined sharply in the mid-1940’s, leading to its eventual complete collapse in the early 1960’s due to overfishing (McCrae 1994), Pacific sardine was an extremely important commercial fish. In recent years it has been recovering in numbers, leading the California Department of Fish and Game to indicate that the Pacific sardine resource has fully recovered (CDF&G press release). The directed fishery harvests for the potentially growing sardine industry in southern California are mostly canned for human consumption overseas, with a small proportion sold fresh for human consumption or animal food. Pacific sardine are also important prey for a wide selection of fish, seabirds, and marine mammals.

The Southern California coast is the main spawning ground for Pacific sardines. Pacific sardine spawn pelagic eggs and larvae year round with a fall and winter minimum and a spring and summer maximum. The females may lay upwards of 200,000 eggs in a season, which hatch in about three days. They will mature between 7 and 9.5 inches sometimes within their first year. They can live up to 25 years and grow to a maximum size of about 16 inches (McCrae 1994). Pacific sardines conduct annual migrations northward early in summer and return southward in fall, migrating farther with each year of life.

In the 2003 impingement, Pacific sardines were the third most abundant species with an estimated 63,339 individuals impinged for the year (table). This made up 1.8 percent of the total impingment for 2003 (Table 2-1). Over 70 percent of the Pacific sardine impingement occurred from July to October (Table 2-2).

3.3.4 White Croaker

The white croaker is one of eight species of the family Sciaenidae (drums/croaker) found along the California coast. The white croaker is an important commercial and sport fish in California. The majority of the fish are sold at fresh fish markets under the name kingfish and there is also a small market for use as bait fish. White croaker are found from Baja California to British Columbia, usually at depths of 6 to 75 m within bays and estuaries that have sandy bottoms (Wang 2001).

White croaker may spawn throughout the year, but the majority of spawning takes place from January to March in southern California (Gregory 2001). Females can spawn up to 24 times in a season producing a maximum of 37,200 eggs per spawning (Gregory 2001). The eggs hatch in about one week. Eggs and larvae are pelagic, and post-flexion larvae settle to the bottom as they develop (Love 1984). Juveniles are found near the bottom in 3-6 m of water, then migrate to deeper water as they mature. Both sexes mature between one to four years with a size range of 5.5 to 7.5 inches (Gregory 2001). The maximum recorded length of a white croaker is 16.3 inches, but most fish will generally grow to about 12 inches.

Impingement monitoring at SONGS indicates an overall decline in white croaker impingement until 1999, after which impinged numbers of this species increased (SCE 2003). In the 1979-1980 entrainment monitoring program, white croaker were the second most abundant species entrained.

3.3.5 Kelp/Sand Bass

Kelp bass (Paralabrax clathratus), sand bass (P. nebulifer) and spotted sand bass (P. maculatofasciatus) are members of the family Serranidae (sea basses and groupers). All three species are popular with southern California recreational fishermen. Kelp bass and sand bass are frequently caught by commercial passenger fishing vessels (CPFVs) and private boaters in the vicinity of the San Onofre Nuclear Generating Station. Spotted sand bass are typically restricted to sandy or muddy bottom habitat within shallow bays, harbors, and coastal lagoons (Hovey and Allen 2001) and are found infrequently near SONGS. Early records of the commercial catch of these three similar species were grouped as “rock bass”. A steady decline in the catch of rock bass following World War II prompted conservation measures, which in 1953 made commercial fishing for rock bass illegal in California waters.

Kelp bass are typically found in shallow water from the surface to 150 feet (46 m) closely associated with high relief structures, including kelp. They range throughout the water column, but seem to concentrate between eight and 70 feet (2.4 and 21.3 m.) In general they live solitary lives but form assemblies to spawn and to feed on small schooling fish including anchovies, sardines, surfperch and queenfish. They also eat squid, octopus, crabs, shrimps and amphipods. Spawning occurs primarily around the full moon from April through November peaking in the summer months. Kelp bass produce pelagic eggs 0.04 inches (0.1 cm) in diameter (Allen and Hovey 2001). Larvae remain in the plankton for 28 to 30 days at which time they settle out in shallow water in attached as well as drift algae including kelps.

Barred sand bass form large breeding aggregations over sandy bottoms at depths of 60 to 120 feet in the summer months. Spawning occurs from April through November, usually peaking in July. Barred sand bass produce a large number of small pelagic eggs that enter the plankton in coastal waters. Young of the year sand bass begin appearing in shallow, nearshore waters in the early fall. (Allen and Hovey 2001)

Spotted sand bass spawn in the warm summer months, from late May to early September and the multiple sized oocytes in gravid females indicates that this a multiple spawning species. They grow rapidly during their first two years. Some may reach as much as 8.8 inches (22.4 cm) at the end of their first year. (Hovey and Allen 2001)

Kelp bass and barred sand bass are common in fish impingement samples at SONGS and eggs and larvae of this genus have been common in plankton samples taken in the vicinity of SONGS.

3.3.6 Spiny Lobster

The California spiny lobster ranges from Monterey Bay, California to Manzanillo Mexico and a small part of the Gulf of California. The majority of the population is found between Point Conception, California and Magdalena Bay, Baja California. Adult lobsters usually inhabit rocky areas from the intertidal zone to depths of 240 feet or more.

Spiny lobsters mate from November through May. Fertilized eggs are attached to the underside of the female’s tail primarily in May and June. “Berried“ females are generally in water less than 30 feet (9.1 m) deep and carry their eggs for about 10 weeks. Sampled females carried between 120,000 and 680,000 eggs, depending on the size of the female.

Spiny lobster eggs hatch into tiny, transparent larvae known as phyllosomas that go through 12 molts. They drift with the prevailing currents feeding on other planktonic animals. They may drift offshore out to 350 miles (563 km), and may be found from the surface to a depth of over 400 feet (122 m). After five to nine months, the phyllosoma transforms into the puerulus or juvenile stage which actively swims inshore where it settles to the bottom in shallow water and starts to grow if the habitat is suitable. (Barsky 2001)

Spiny lobsters are important to the commercial fisheries and sport diving community of southern California. From 1989 through 1999 commercial landings ranged from 600,000 to 950,000 pounds (272,155 to 430,912 kg) per year in California. (Barsky 2001). Spiny lobsters are occasionally observed during fish impingement sampling at SONGS and are frequently released by the FRS during fish return and “Fish Chase” procedures.

4. PROPOSED IMPINGEMENT MONITORING

As discussed in Sections 2.3.1 and 2.4, there is a substantial amount of data on impingement at SONGS over the life of the units, limited only in that sampling has been conducted only quarterly since 1999. One year of additional sampling is proposed to provide current impingement data, reflecting current conditions in the Southern California Bight near the Station and accounting for temporal variations in impingement by sampling at increased (biweekly) frequency (SCE 2003).

Data produced by this monitoring program will define the species and life stages impinged, as well as their numbers and biomass on a time (biweekly and annual) and per-volume-pumped (MG of cooling water) basis for each of the two intakes. The results will be incorporated into the IM&E Characterization Study, as described in Section 1.2.

This section addresses the proposed sampling plan, sampling gear and the method for its deployment, sample processing procedures, collection of relevant ancillary information, and data analysis. A quality assurance program for the impingement monitoring program is described in Section 6.

4.1 IMPINGEMENT SAMPLING

The impingement monitoring program is recommended to span at least one year (12 months) and to include both units 2 and 3. A second year of monitoring should not be necessary given that interannual variations can be characterized based on many years of impingement monitoring at the Station.

Impingement will be sampled over one continuous 24-hour period every other week throughout the year, and all operating screens will be sampled at the same time. Sampling will be scheduled to begin on the same day (e.g., Tuesday). If none of the units is scheduled to operate during the specified day of sampling, an alternate sample day during the same bi-weekly period will be selected in order to get representative fish density (number of impinged fish per flow volume) measurements. Biweekly sampling should be sufficient to describe seasonal patterns in impingement, as requested in the Phase II Rule, and data from the additional year of monitoring can be used together with biweekly monitoring results from years prior to 1999 to account for interannual variation in impingement.

Sampling to detect diel variations in impingement is not possible given the existing regulatory water quality objectives. This is because most impingable fish entering the SONGS CWIS are able to resist impingement by swimming away from the screens or finding quiescent areas where they can temporarily reside. These fish may reside for days or weeks before being impinged. Sampling impingement every six hours, for instance, would not accurately depict which fish entered the intake during the past six hours unless a toxicant was added to the water to sweep the screenwell clean every six hours. Instead, the SONGS Comprehensive Demonstration Study will depend on historical studies dealing with diel variations in impingement. Diel variations in entrainment of larvae will be possible to measure because these organisms are unable to resist the flow velocities found in the SONGS screenwell.

4.1.1 Impingement Sampling Gear and Deployment

Sampling gear and deployment for these studies will be the same as used in prior impingement monitoring at SONGS. Prior to sampling, the traveling screens will be rotated for at least one full cycle to remove fish and debris accumulated prior to the sampling interval. Once this cleaning process has been accomplished, sampling will be initiated by placing the collection basket at the outfall of the screen wash troughs for Units 2 and 3. The collection baskets or nets will have 3/8-inch mesh.

The collection baskets will be removed and their contents will be emptied into a receiving bin allocated for that collection interval, and subsequently processed. The collection baskets are sufficiently sized at SONGS, and will be emptied frequently enough, to prevent overflow caused by debris buildup during the collection interval. Fish and debris can be removed from the collection baskets or nets anytime during the 24-hour period if there is any risk of them becoming too full and overflowing. However, overflow drains surrounding the collection bins at SONGS re-circulate any overflow back to the collection bin.

This sampling process will be repeated during each of the 24-hour sampling periods.

4.1.2 Impingement Sample Processing

Samples from the two screen wash troughs (Unit 2 and Unit 3) will be kept separate during processing. Each sample will be processed by counting and identifying all fish to the lowest practicable taxonomic level. Individuals that cannot be identified to species in the field will be preserved for future identification by a taxonomy expert (see Section 6).

Fish in the sample will be sorted by species and counted. Following sorting, each fish will be measured to the nearest mm, standard length (SL), except elasmobranches which will be measured by total length (TL). If the number of specimens in the sample for a particular species is large, the species count can be estimated by subsampling. A subsample of 100 individuals of each species will be weighed and the total sample will be weighed. The number of individuals in the whole sample will be estimated from the ratio of the total sample weight to the subsample weight total and the count within the subsample. Lengths will be measured for 100 individuals in the subsample, or all of them if less than 100 occur.

The general condition of impinged organisms will be observed as they are processed. Unusual condition, such as signs of disease, parasites or injury, will be noted. Samples may be frozen at the completion of processing and saved for possible inclusion in quality control (QC) testing. Once it is determined that a sample is no longer needed for QC purposes, it will be disposed of in an approved manner. QC of sample processing is discussed in Section 6.

4.2 FISH RETURN SYSTEM SAMPLING

The fish return system (FRS) monitoring program is recommended for one year (12 months) and to include both Units 2 and 3. The duration of the monitoring program will ensure efficiency data is collected during peak impingement and bypass periods and over the range of life stages and sizes representative of entrapment at the Station. The purpose of the monitoring program is to verify the FRS performance efficiency estimates from prior studies and attempt to provide unbiased estimates of FRS performance for fish <50 mm in length (see Section 5.2). The FRS monitoring program shall be conducted in conjunction with impingement sampling, to determine the diversion efficiency of the fish return system. Samples will be collected from the fish elevator at 12 hour intervals over two 24-hr periods each month using gear and methods described in the prior FRS studies (Love et al 1989), modified to also sample larval fish. The sample will coincide with the 24-hour impingement sample. All four circulating water pumps will be operated during the sample. If any pumps are out of service, the FRS sample and the impingement sample will be rescheduled during the same biweekly impingement period. During each sampling interval, the contents of the elevator basket will be sampled using two 15-inch diameter nets (on of 3/8" mesh, one of 0.5 mm mesh) to collect juvenile and older fish as well as larvae. The first net will use 3/8" mesh to catch impingeable fish. The second net will use 0.5 mm mesh to retain entrainable larvae. Mesh sizes may be adjusted, if necessary, to improve sampling efficiency. Any changes in equipment or procedures used in this sampling will be requested in advance of the CRWQCB. As fish are poured into the sluiceway, two aliquot samples are taken with the intent to sample at least one tenth of the fish collected (Love et al 1989). This process is repeated until fish are no longer present in the elevator basket.

Prior to sampling with nets, any fish in the return elevator that are stunned or dead will be recorded by species, estimated length, and condition. Fish in the net samples will be sorted by species and counted. Following sorting, each fish will be measured to the nearest mm standard length (SL). If the number of specimens in the sample for a particular species is large, the species count can be estimated by subsampling. A subsample of 100 individuals will be weighed and the total sample will be weighed. The number of individuals in the whole sample will be estimated from the ratio of the total sample weight to the subsample weight total and the count within the subsample. Lengths will be measured for 50 individuals in the subsample. Individuals that cannot be identified to species in the field will be preserved for future identification by a taxonomy expert (see Section 6).

The general condition of netted organisms will be observed as they are processed. Unusual condition, such as signs of disease, parasites or injury, will be noted. Samples may be frozen at the completion of processing and saved for possible inclusion in quality control (QC) testing. Once it is determined that a sample is no longer needed for QC purposes, it will be disposed of in an approved manner. QC of sample processing is discussed in Section 6.

4.3 FISH CHASE EFFECTIVENESS SAMPLING

The fish chase monitoring program is recommended for one year and to include all heat treatments at Units 2 and 3. The fish chase and subsequent heat treatment operations are typically conducted on an as-required basis depending on the amount of biofouling in the intake conduit; a total of nine heat treatments were conducted for Unit 2 and seven for Unit 3 in 2003.

The fish chase monitoring program will follow sampling procedures used in previous monitoring studies. Water temperatures will be elevated slowly to agitate fish residing in the CWIS. These fish are guided toward the fish return by manipulating cross-over gates in the screenwell which slowly warms the water and creates eddy currents to dislodge fish residing in low flow habitats. A target temperature of 83ºF will be used during fish chase operations, however higher temperatures are sometimes needed to dislodge warm water species such as yellowfin croaker, sargo, and zebra perch (SCE 2003). The process dislodges fish and causes them to move toward the fish return system. The operation shall be monitored by fisheries biologists to ensure fish are not being overly stressed. The number of fish impinged during heat treatment operations and the number of fish released back to the ocean during fish chase procedures will be recorded along with data on fish condition, species composition, operational status, and water temperatures.

Each sample will be processed, as is currently done, by counting and identifying all fish visually to the lowest practicable taxonomic level. In order to save as many fish as possible and work within the critical time/temperature path, no sampling is possible.

4.4 RELEVANT ANCILLARY INFORMATION

There is ancillary information that will be recorded that is relevant to environmental conditions at the time of impingement monitoring, as well as plant operation data needed to estimate total impingement. Environmental data relevant to each sample will be recorded on an accompanying field data sheet. In addition to date and sample start/end time recordings, these data will include operation parameters for the intake (identify screens and pumps operating); tidal stage; and water temperature and water clarity all recorded at the beginning of each collection. A unique sample identification number will be assigned to each sample. Other relevant observations to be recorded include air temperature, wind speed, cloud cover, and precipitation.

Plant operation records must be available to determine the operation regime during the sampled and unsampled days in each month. Data required include hourly pumping rates (or volumes) for each unit, generation output (MWh), and discharge water temperature. Pumping rate or volume data will allow impingement estimates to be based on per unit volume pumped.

4.5 DATA ANALYSIS

The objectives of the impingement data analysis will be to:

1. define the fish species impinged;
2. estimate impingement rates expressed as density per million gallons (MG) of cooling water pumped on a daily, biweekly, and annual basis;
3. estimate total numbers and biomass by species on a biweekly and annual basis for the year of sampling;
4. characterize impinged fish in terms of size and age distribution by species;
5. estimate effectiveness of the fish return system; and
6. estimate the effectiveness of fish chase operations.

The results of the proposed new studies will be used in conjunction with available information from prior studies at SONGS, as well as information from studies at other power plants and the general literature, to estimate the effectiveness of the existing fish protection features of the SONGS intake for reducing impingement mortality (Figure 4-1). As shown in figure 4-1, historical information that will be used includes, but is not limited to:

- Annual impingement monitoring conducted at SONGS since 1983;

- Velocity cap studies conducted by the University of Washington, Fisheries Research Institute at Huntington Beach and Ormond Beach Generating Stations;
- Previous 316(b) studies conducted at SONGS Unit 1;
- Prior FRS studies conducted at SONGS;
- Prior fish chase monitoring conducted at SONGS;
- Impact analyses completed by the Marine Review Committee for the California Coastal Commission, and
- Other existing and future available information relevant to the evaluation of impingement and the effectiveness of the existing SONGS fish protection technologies, including laboratory studies and studies conducted at other cooling water intake systems.

Estimates of the individual effectiveness of the velocity cap, FRS, and fish chase procedure will be made based on all available information and combined to yield an estimate of the total percent reduction in impingement mortality from the fish protection technologies and operations existing at SONGS. The results will also be used to estimate the annual impingement mortality for the Calculation Baseline (Figure 4-1). Results of the proposed additional year of impingement monitoring and prior monitoring studies at SONGS will be used to characterize interannual variation in impingement rates.,

Impingement rates characteristic of SONGS, expressed as density per million gallons (MG) of cooling water pumped and adjusted to reflect the impingement rates for the Calculation Baseline (i.e., in the absence of SONGS' fish protection controls), will also be used to estimate reductions in impingement mortality associated with scheduled outages occurring over a 5-year period of forecasted Station operations.

Study results will be incorporated into the IM&E Characterization Study and submitted as part of the CDS, as discussed in Section 1.2.

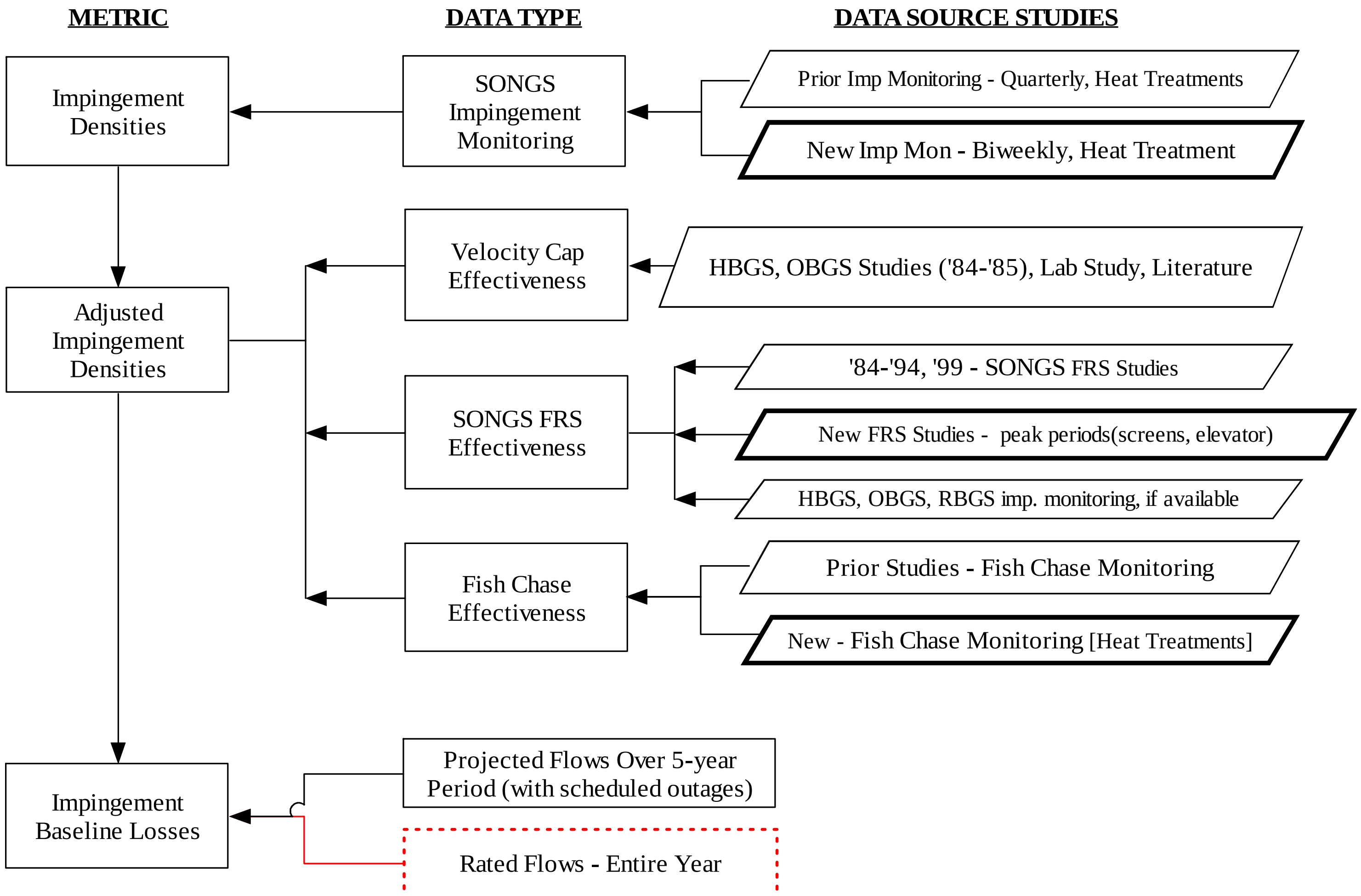

Figure 4-1. Conceptual model for estimating baseline impingement losses at the San Onofre Nuclear Generating Station (proposed field studies shown in bolded boxes).

5. PROPOSED ENTRAINMENT MONITORING

As discussed in Section 2.3.2, entrainment monitoring was conducted at the San Onofre Nuclear Generating Station during 1979 and 1980 at Unit 1 (prior to construction of Units 2 and 3). Additional studies, focusing on Units 2 and 3, ran from August 1979 through September 1986. These studies included pre- and post-operational periods so that a Before-After-Control-Impact (BACI) analysis could be utilized to estimate entrainment losses. This monitoring provides useful, but dated entrainment information for SONGS, as the data was collected over 19 years ago.. The proposed entrainment monitoring will supplement the previous studies and will document the current entrainment rates and species and life stage composition in entrainment samples. The following sections describe the sampling design, equipment and methodology. One full year of entrainment monitoring will be conducted.

5.1 ENTRAINMENT AND SOURCE WATER SAMPLING DESIGN

Entrainment monitoring will be done biweekly for one year. This sampling frequency has been widely used as the standard for entrainment sampling at other facilities, including recent studies in California, and considered adequate to describe seasonal patterns in entrainment, as requested in the Phase II rule (EPRI 2005).

Sampling will occur over a full 24-hour period for each sampling event. Sampling will be scheduled to begin on the same day of the week (e.g., Tuesday). One sample will be taken every 6 hours according to the following time intervals: 0-0600, 0600-1200, 1200-1800 and 1800-2400 hours). Exact sampling dates may fluctuate depending on required nuclear maintenance outages and heat treatment schedules.

5.1.1 Entrainment Sampling Gear and Deployment

Samples will be collected within the CWIS intake screenwell in front of the traveling bar racks. Samples will be collected by use of standard plankton nets. Final sampling protocol will be selected in consultation with the CRWQCB, considering representativeness of actual entrainment, temporal coverage of sampling, sampling accuracy and precision, and constraints imposed by operational and safety requirements at SONGS. As part of an overall evaluation of the best practicable sampling location and gear for entrainment monitoring at SONGS, a pilot study will be conducted to compare ichthyoplankton densities collected in standard plankton tows at the SONGS intake (Source Water samples) with densities obtained using plankton nets within the station’s cooling water system. A series of at least ten concurrent samples will be collected during the same time period at the beginning of the sampling program.

In-plant entrainment samples will be collected from the well mixed area at the cooling water intake screenwell within the station site (Figure 5-1). Sampling will be performed using a standard plankton net with a 60-cm diameter net ring with 333-µm Nitex© nylon mesh. Each net will be equipped with a calibrated flowmeter, allowing the calculation of total flow volume. Each sample will sample a minimum of 30 m^3 of water. Larger samples will be obtained if feasible. Clogging of the plankton nets may limit sample volume because of

SONGS' location adjacent to kelp forests. Netting will be of sufficient size and surface area to reduce the likelihood of net extrusion of smaller larvae and net overflow

5.1.2 Source Water Sampling Gear and Deployment

Samples will be collected as close as practicable to the intake. These samples are designed to characterize the larvae of target species occurring in the vicinity of the intake and provide a comparison to historical data. Samples will be collected by use of standard plankton nets. Samples will be collected monthly at 6-hour intervals over 24-hour period, coinciding, when possible, with in-plant entrainment monitoring. Netting will be of sufficient size and surface area to reduce the likelihood of net extrusion of smaller larvae and net overflow

The offshore net samples will be collected with equipment similar or equal to that used in-plant, a bongo frame fitted with 60-cm diameter net rings with plankton nets constructed of 333-µm Nitex© nylon mesh. Each net will be equipped with a calibrated flowmeter, allowing the calculation of total flow volume.

Each sample will process a minimum of 30 m^3 of water. Larger samples will be obtained if feasible. Clogging of the plankton nets may limit sample volume because of the proximity of the SONGS intake to adjacent kelp forests.

5.1.3 Sample Processing

At the conclusion of the samples, the nets will be washed down to concentrate captured organisms and detritus in the collection cup attached to the net. The concentrated sample will be preserved in a 4-percent buffered formalin-seawater solution, then, after approximately 72-hours, will be transferred to 70% ethanol solution. Further processing of the sample will occur in the laboratory.

In the laboratory, fish larvae, juveniles and targeted invertebrate larvae will be sorted and removed from the sample. If the sample contains a large number of specimens or a large amount of detritus, subsampling will be performed using a Folsom splitter or other appropriate sample volume splitting device. If subsampling becomes necessary, subsamples will be processed until a minimum of 200 identifiable specimens are found, but counts for individual subsamples will be maintained. Fish eggs will not be sorted or identified because a full assessment of their abundance would require different sampling techniques and they cannot be identified to the same taxonomic levels as fish larvae.

Technicians trained in taxonomy will identify the specimens to life stage and the lowest practicable taxon. Counts will be made by species (taxon) and life stage. Up to 30 specimens per species and life stage will be measured to the nearest 0.1 mm.

5.2 FISH RETURN SYSTEM STUDIES

The fish return system (FRS) monitoring program is proposed for one year (12 months) at both Units 2 and 3. The monitoring program shall be conducted monthly in conjunction with the impingement studies discussed in Section 4.2, with the objective to quantify the diversion efficiency of the FRS for small fish (<50 mm), including larvae and early juveniles, that may otherwise be entrained at an intake without this fish protection technology.

In conjunction with impingement and entrainment sampling, 24-hour fish elevator samples will be collected once per month. All four circulating water pumps will be operated for the unit to be sampled. For each interval, the contents of the elevator basket will be sub-sampled using two 15-inch wide “double” nets equipped with both large (approximately 5 mm) mesh to catch larger fish and debris followed by a second net of approximately 1-2 mm mesh, sufficient to collect larger larvae and early juveniles. Based on initial testing, the process will be adjusted to sample a portion of the elevator volume sufficient to yield at least 200 fish per sample (number of organisms). This process is repeated until fish are no longer present in the elevator basket.

If the number of specimens in the sample for a particular species is large, the count and condition may be taken on a subsample.

In the laboratory, all fish larvae and juveniles will be sorted and removed from the sample. If the sample contains a large number of specimens, subsampling will be performed using a Folsom splitter or other appropriate sample volume splitting device. If subsampling becomes necessary, subsamples will be processed until a minimum of 200 identifiable specimens are found, but counts for individual subsamples will be maintained. Technicians trained in taxonomy will identify the specimens to life stage and the lowest practicable taxon. Counts will be made by species (taxon) and life stage. Up to 30 specimens per species and life stage will be measured to the nearest 0.1 mm.

5.3 RELEVANT ANCILLARY INFORMATION

There is ancillary information that must be recorded relevant to environmental conditions at the time of entrainment monitoring, as well as plant operation data needed to estimate total entrainment. Environmental data relevant to each sample will be recorded on an accompanying field data sheet at the start of each 6-hour entrainment sampling period or 24-hour impingement and FRS sampling period. In addition to date and sample start/end time recordings, these data will include operation parameters for the intake (identify pumps operating); tidal stage; and water temperature, and water clarity, all recorded at the beginning of each collection. A unique sample identification number will be assigned to each sample. Other relevant observations will be recorded, such as air temperature, wind speed, cloud cover, and precipitation.

Plant operation records will be obtained to determine the operation regime during the sampled and unsampled days in each month. Data required include hourly pumping rates (or volumes) for each unit, generation output (MWh) and discharge water temperature.

5.4 DATA ANALYSIS

The objectives of the entrainment data analysis will be to:

1. define the fish species and life stages entrained;
2. estimate entrainment rates expressed as density per million gallons (MG) of cooling water pumped on a daily, biweekly, and annual basis;
3. estimate total numbers entrained by species on an hourly (for diel variability), biweekly (for seasonal variability), and annual basis for the year of sampling;
4. characterize the life stage and size distribution of entrained organisms; and

5. estimate the effectiveness of the fish return system for reducing entrainment of larval and juvenile fish.

The results of the proposed new studies will be used in conjunction with available information from prior studies at SONGS, as well as information from studies at other power plants and the general literature, to estimate the effectiveness of the existing fish protection features of the SONGS intake for reducing impingement mortality. As shown in Figure 5-2, historical information that will be used includes, but is not limited to:

- Prior entrainment and near-field ichthyoplankton monitoring conducted at SONGS;
- Prior FRS studies conducted at SONGS;
- Other existing and future available information relevant to the evaluation of entrainment and the effectiveness of the existing SONGS fish protection technologies, including laboratory studies and studies conducted at other cooling water intake systems.

Estimates of the effectiveness of the FRS will be made based on all available information and used to calculate a percent reduction in entrainment from this fish protection technology. The results will also be used to estimate the annual entrainment for the Calculation Baseline (Figure 5-2). Results of the proposed additional year of entrainment monitoring and prior entrainment (1979-80) and nearfield ichthyoplankton (1982-86) monitoring studies at SONGS will be used to characterize interannual variation in entrainment rates,

Entrainment rates characteristic of SONGS, expressed as density per million gallons (MG) of cooling water pumped and adjusted to reflect the entrainment rates for the Calculation Baseline (i.e., in the absence of SONGS' fish protection controls), will also be used to estimate reductions in entrainment associated with scheduled outages occurring over a 5-year period of forecasted Station operations.

Study results will be incorporated into the IM&E Characterization Study and submitted as part of the CDS, as discussed in Section 1.2.

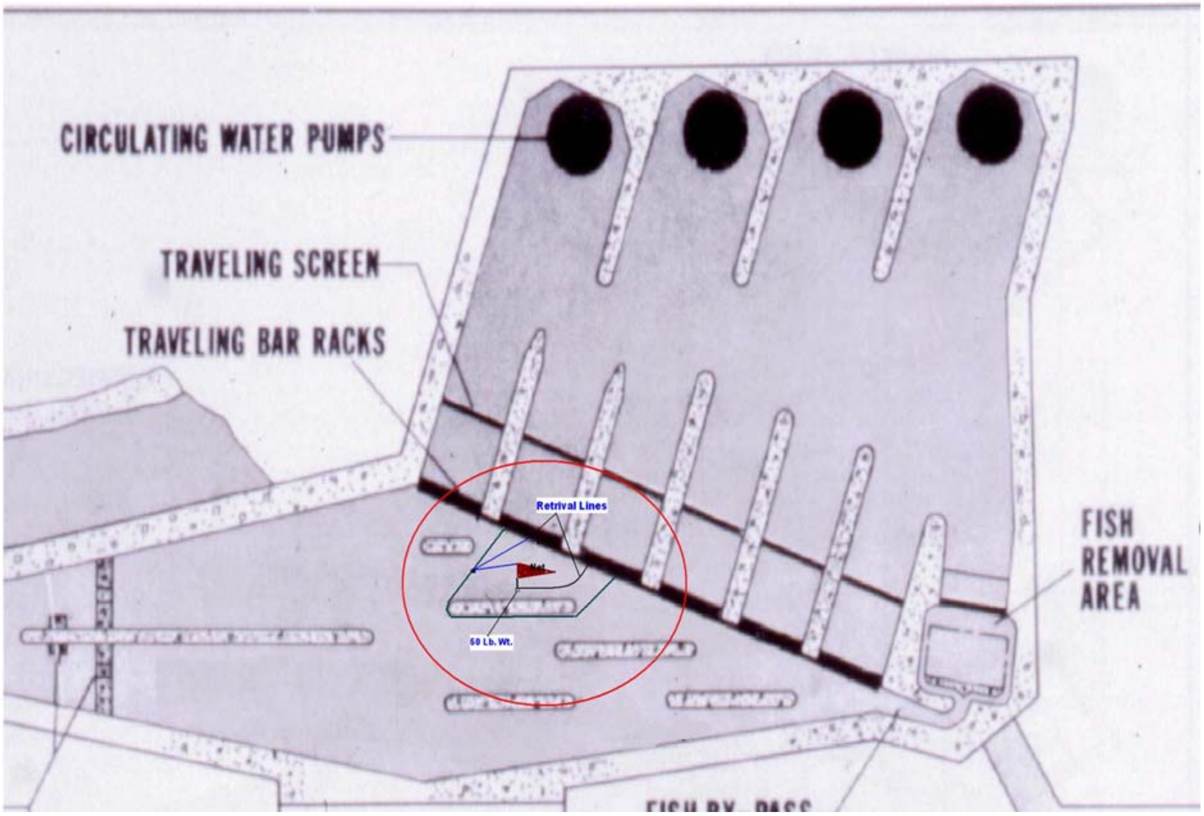

Figure 5-1. Location of In-Plant Entrainment Sampler.

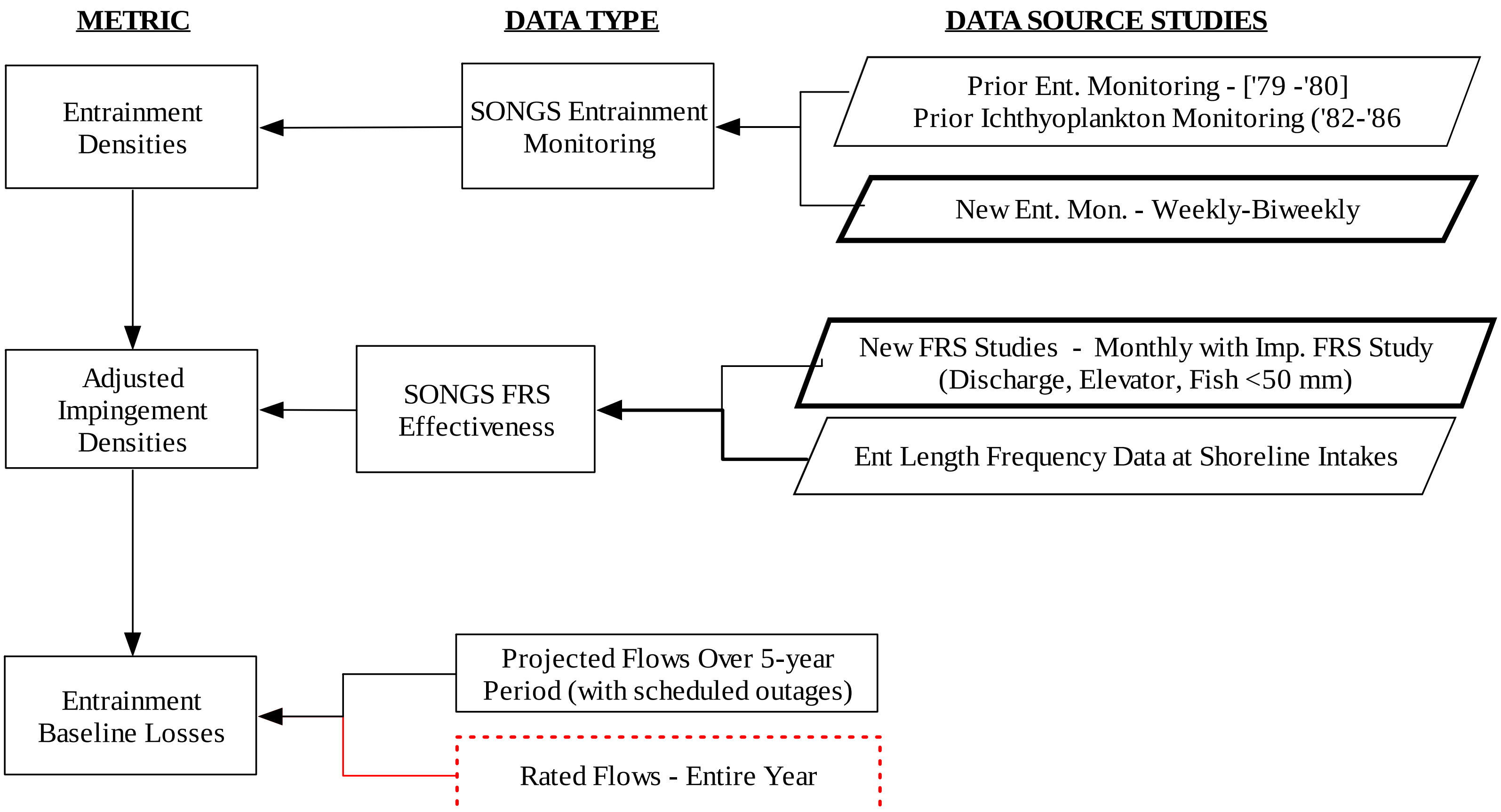

Figure 5-2. Conceptual model for estimating baseline entrainment losses at the San Onofre Nuclear Generating Station (proposed field studies shown in bolded boxes).

6. QUALITY ASSURANCE

An essential part of the proposed monitoring programs will be a quality assurance plan instituted to ensure that the data generated by the programs meet an acceptable standard of quality. Quality assurance (QA) is defined as an integrated system involving quality planning, quality control, quality assessment, quality reporting, and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. The USEPA has published guidance documents (e.g., USEPA, 1995, USEPA 2000; USEPA 2002a, USEPA 2002b) for preparing and implementing project-specific quality assurance plans for their staff and for contractors funded by their organizations to follow, known as Quality Assurance Project Plans (QAPPs). These documents will be used to prepare a QAPP that fits the needs of the proposed impingement and entrainment programs prior to the initiation of sampling.

A QAPP has four basic element groups: project management, data generation and acquisition, assessment and oversight, and data validation and usability. Within these four groups there can be as many as 24 elements. Rather than address each of these elements, the following highlights aspects that are particularly relevant to the execution of these programs.

6.1 PROGRAM MANAGEMENT

This Impingement and Entrainment Sampling Plan provides many of the elements necessary for the program management functions of a QAPP, such as problem definition and background, and project and task descriptions. Other program management functions of a QAPP that are provided in the Plan include presentation of the project objectives and the interrelationships among the project tasks that direct the course of studies and identify information endpoints. An important element is the project organization, which identifies the roles and responsibilities of project personnel. A project organization chart identifies project personnel, whose qualifications (e.g., experience and specialized training) can be reviewed, as well as lines of communication and authority. The project organization chart will show individuals whose responsibility is to conduct various aspects of the quality assurance program.

The QAPP will set data quality objectives and criteria. Methods will be specified to ensure the desired level of precision, comparability, and completeness. In terms of impingement mortality and entrainment quantification, the USEPA has not set standards for precision of estimates, so the sampling design proposed in this Plan conforms to sampling effort and precision levels that currently are standard practice. If the USEPA publishes guidance on sampling methods in the future, including QA standards and desired or required levels of precision, the program design and methodology will address these standards.

6.2 DATA GENERATION AND ACQUISITION

This component of the QA program is the heart of the field and laboratory tasks undertaken to generate data on current impingement and entrainment rates at SONGS. Elements include sampling design, sampling methods, sample handling and custody, analytical methods, instrument maintenance and calibration, and quality control. Quality control is defined as activities whose purpose is to measure and control the quality of a procedure so that it meets the needs of its user. Quality control (QC) activities monitor the outgoing quality of the data and can lead to response actions to bring the data within control limits through various actions, such as retraining of personnel, repair or recalibration of equipment, or other similar actions.

Sampling methods will be standardized so that they are repeatable and produce data that are comparable through time. This will be accomplished by preparing detailed Standard Operating Procedures (SOPs) for all activities, including sampling location and frequency, sampling gear and deployment, sample processing, data coding and recording, database entry, and to some degree, data analysis. The SOPs can be reviewed by all parties to reach consensus on their applicability, and will be adhered to by all project personnel. SOPs will provide a description of procedures to follow if obstacles to sampling or completion of all sampling activities are met, so that the acquisition of quality data can be maximized. The SOPs will describe procedures for sample handling and custody, including required signatures and blank forms for associated labels and logs. Also included will be project-specific data sheets, variable definitions and coding instructions. Equipment and instrument specifications will be described, including levels of precision and calibration methods for ensuring accuracy.

Systematic QC procedures will be instituted to verify recorded data. The primary area where these QC procedures will be used is sample processing, e.g., sorting of eggs and larvae from detritus in entrainment collections, impingement fish counts, species identification, and length and weight measurements. Processed impingement and entrainment samples may be subjected to a statistically-based QC procedure, such as continuous sampling plans (CSP) or MIL-STD 105 methodology derived from a manufacturing environment and applied to environmental monitoring programs (Young et al. 1992). The sampling plans implemented under these procedures have a specified average outgoing quality limit (AOQL), which represents the maximum fraction of all items (e.g., measurements, taxonomic identifications or counts) or lots (e.g., whole samples) that could be defective as a worst case. A defective item could be a measurement or count that falls outside of a specified tolerance limit (e.g., plus or minus 1 to 10 percent). In practice, the average outgoing quality (AOQ) is typically much better than the AOQL.

6.3 ASSESSMENT AND OVERSIGHT

Assessment and oversight is the process of determining whether the QA plan is being implemented as designed. For the proposed programs, this will be accomplished primarily by conducting technical audits or surveillance of field, laboratory and data management activities. Experienced senior staff, designated by the organization chart, will accompany field personnel during a set number of sampling events to observe sampling activities and to verify that SOPs are being followed properly. These auditors also will observe laboratory and data management personnel during their activities on specified occasions. Variances from approved procedures will be documented and corrected, either by modifying SOPs to address any systematic problems or by testing and/or retraining staff, as necessary. Prior to the first scheduled sampling, a readiness review will be conducted to ensure that trained personnel, required equipment, and procedural controls (e.g., SOPs) are in place. A technical audit will be scheduled for the first month of sampling (or very soon thereafter) so that any necessary corrections can be made before significant data losses occur. Follow-up audits will be scheduled (e.g., quarterly) to monitor progress and address changing conditions, such as recruitment of new life stages or species, entrainment or impingement abundances, river stage or flow, new personnel, or plant operations.

Another QC aspect for oversight is the maintenance of a voucher specimen collection and library of taxonomic keys and references to assist personnel with taxonomic identification. The voucher specimen collection will consist of preserved specimens that have been positively identified by a qualified taxonomist. Oversight also will be provided by procedures requiring that specimens that are not positively identifiable by field or lab personnel will be preserved and given to a qualified taxonomist for identification.

6.4 DATA VERIFICATION, VALIDATION AND USABILITY

Data verification and validation will be conducted by qualified biologists (e.g., QA manager or field/lab supervisors) during the course of the project to ensure that the resulting data will be suitable for use as intended. Project records, including field sampling logs, raw data sheets, sample chain-of-custody forms and instrument calibration logs, will be reviewed to verify that data were collected according to the QAPP. Data will be validated first by a review of datasheets and data files to find whether data are incomplete or appear to be inappropriate or out of a reasonable range of values. Data entry into the database also will undergo a 100 percent visual QC comparison to the data on the corresponding data sheets. Finally, data files will be subjected to error checking programs to detect outlying values either to investigate further or to eliminate if shown to be spurious. This investigation will require tracing the data to raw data sheets and consulting with field or lab personnel who recorded the data. All raw data sheets, log books and data files will be maintained for future reference. All computer files will be backed up on a daily basis while any data entry or editing procedures are ongoing.

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B PROPOSED METHOD FOR EVALUATION OF ENVIRONMENTAL BENEFITS

See following pages.

Deriving Economic Benefits of Reduced Impingement and Entrainment at SCE's San Onofre Nuclear Generating Station

Background

For use of the Cost-Benefit test under the site-specific standards, Southern California Edison is required to have a Benefits Valuation Study prepared. The final 316(b) Phase II Final Rule (herein after referred to as the Rule) requires use of a comprehensive methodology to value fully the impacts of impingement and entrainment mortality at the San Onofre Nuclear Generating Station (SONGS). Other requirements for use of the test include:

- A description of the methodology(ies) used to value commercial, recreational, and ecological benefits (including non-use benefits, if applicable);
- Documentation of the basis for any assumptions and quantitative estimates. If the valuation includes use of an entrainment survival rate other than zero, a determination of entrainment survival at the facility based on a study approved by the NPDES permitting authority must be submitted;
- An analysis of the effects of significant sources of uncertainty on the results of the study;
- If requested by the NPDES permitting authority, a peer review of the items you submit in the Benefits Valuation Study. You must choose the peer reviewers in consultation with the Director who may consult with EPA and Federal, State, and Tribal fish and wildlife management agencies with responsibility for fish and wildlife potentially affected by your cooling water intake structure. Peer reviewers must have appropriate qualifications depending upon the materials to be reviewed.
- A narrative description of any non-monetized benefits that would be realized at your site if you were to meet the applicable performance standards and a qualitative assessment of their magnitude and significance.

All benefits, whether expressed qualitatively or quantitatively, should be addressed in the Benefits Valuation Study and considered by the NPDES permitting authority and in determining whether compliance costs significantly exceed benefits.

The benefits assessment begins with an impingement and entrainment (IM&E) mortality study that quantifies both the baseline mortality as well as the expected change from rule compliance. Based on the information generated by the IM&E mortality studies, the benefits assessment includes a qualitative and/or quantitative description of the benefits that would be produced by compliance with the applicable performance standards at the facility site. To the extent feasible, dollar estimates of all significant benefits categories would be made using well-established and generally accepted valuation methodologies.

In order to have the appropriate information if the benefit/cost option is chosen, we propose a strategy for the collection and analysis of economic information. The strategy is based on information obtained during the development of the Strategic Compliance

Plan. It should be noted that one particular benefit category, benefits accruing to individuals even if they have no plans ever to use resources associated with SONGS (non-use benefits), are to be estimated only

> "In cases where the impingement or entrainment study identifies **substantial harm** to a threatened or endangered species, to the sustainability of populations of important species of fish, shellfish or wildlife, or to the maintenance of community structure and function in a facility's water body or watershed ." (Final Rule, Federal Register page 41648).

"Substantial harm" is a stringent requirement to necessitate estimation of non-use values and thus non-use values usually would not be included in the final analysis. However, because the Final Rule does raise the potential for estimation of non-use values, we do provide some contingency for their estimation.

Description of Methodologies to Determine Benefits

The 316(b) rule defines a performance standard that the EPA has established for all existing power plant facilities to meet. The SONGS station is located on the Pacific Ocean and therefore, it is subject to the impingement mortality (IM) performance standard (requiring a reduction in IM of 80% to 95%) and the entrainment (E) reduction performance standard (requiring a reduction in E of 60% to 90%). Recently, EPRIsolutions (2005) identified the lowest cost technology that would meet both the impingement and entrainment mortality performance standard. However, the Final Rule states that facilities do not have to meet the IM and E performance standard if it can be shown that the costs of achieving the performance standard are significantly greater than the benefits. Therefore we are providing a plan to collect information in case it is necessary to determine whether the benefits of the identified technology are significantly less than costs.

Extensive long-term impingement studies, including impingement survival studies have been conducted at SONGS. Entrainment studies were conducted in 1979 and 1980. Based on the Strategic Plan, the potentially representative commercial and recreational species (RS) with impingement and entrainment mortality are likely white croaker, anchovy, and queenfish. If additional impingement and entrainment studies are done and these species continue to the RS, then there may be both commercial and recreational fisheries that benefit from reduced mortalities. It is also possible that non-use values will need to be addressed.

The EPA examined a technology (closed-cycle cooling) to achieve a national standard for entrainment and impingement mortality. In determining benefits at a national level, EPA used certain economic concepts of benefits associated with using the assets that cooling water adversely effects and methodologies to estimate the benefits (U.S. EPA, 2004a; U.S. EPA 2004b; U.S. EPA 2004c). In order to make the benefits comparable to costs, they presented benefits in a monetary unit, dollars. Their benefit estimates reflected the willingness to pay of individuals to go from the current environmental status to one associated with an identified technology. All of the methods proposed in this PIC were also used in EPA's national analysis.

More specifically, this benefit analysis will seek to provide a unit value per fish caught ($/fish) for recreational and commercial species affected by the new technology. With this information, total recreational and commercial benefits can be determined by multiplying the unit value times the expected increase in recreational and commercial catch arising from the identified technology. In addition, some information will be provided with respect to non-use values.

Recreational Angling

For the recreational anglers, there are two potential ways to proceed:

1.) Benefit Transfer- the application of benefit estimates provided in other studies to the SONGS situation;
2.) Primary research- collection and/or assemblage of data on recreational fishing on the Southern California area and using the data to derive an estimate of the value per fish for the important species.

While the two approaches initially will be discussed independently, there is a sound reason to consider them in concert with one another. That is, the benefit transfer information provides a reality check for any values derived in the primary research. Any primary research effort should contain a thorough literature review, a component that would have information very similar in nature to the benefits transfer analysis. Also, the benefit transfer approach may provide a fallback position if the primary research is unsuccessful in providing benefit estimates. After both have been discussed independently, a strategy that integrates them will be offered.

A Benefit Transfer Approach

The use of benefit transfers requires finding a previous economic study (or studies) that considers a comparable situation to fishing near SONGS and contains dollar values per unit fish caught. Particularly important would be having species similar to the effected species and a fishing population similar to the SONGS situation. Although there are numerous other aspects of the fishing situation that might be important, these two are the most critical.

In order to identify an appropriate study or studies, it would be essential to visit the site to examine first-hand the type of recreational fishing that is occurring. At the same time, contact with key people in the area will be made to determine if any relevant studies do exist (see references for some articles). We would consider it essential that the following sources be contacted or examined:

1. State or Federal Hearings on previous SONGS station's license renewal.
2. State or Federal Hearings on previous power plant facilities in the general southern California area.

3. Authors of EPA “in-house” studies associated with the Final Rule. In particular, EPA’s RUM analysis of the California region (U. S. EPA. 2004d) should be considered.
4. Personnel from the National Marine Fisheries Service in La Jolla and California Fish and Game.
5. Key Informants at universities or other research facilities
    a. University of California, San Diego

    Dr. Richard Carson (Department of Economics) is an expert in contingent valuation

    b. University of California, Berkeley

    Dr. Michael Hanneman (Department of Agricultural and Resource Economics) is an expert in economic valuation and has studied sportfishing in southern California

    c. University of California, Los Angeles

    Dr. Trudy Cameron is an expert in econometrics and has studied sportfishing in California.

    d. Southwest Fisheries Science Center, National Marine Fisheries Service

    Drs. Dale Squires and Sam Herrick are experts in fisheries economics and management.

    e. Local Consulting firms. Jones and Stokes Inc. (particularly Thomas Wegge) of Sacramento completed numerous sportfishing studies in California.
6. Existing bibliography sources available by internet
    a. National Marine Fisheries Service, Southeast Fisheries Center
    b. Sportfishing Values Database
    c. Environmental Valuation Reference Inventory (EVRI): Canadian based.
    d. Beneficial Use Values Database (BUVD)
    e. Regulatory Economic Analysis Inventory, (REAI) maintained by the U.S. EPA
    f. ENVALUE, an environmental value database maintained in Australia.
7. *Investigation and Valuation of Fish Kills* (American Fisheries Society, 1992) Excerpt: “Chapter 4 ("Monetary and Economic Valuation of Fish Kills") dates back to the Pollution Committee's *Monetary Values of Fish* booklets of 1970 and 1975, which dealt with southern U.S. species. In 1978, the AFS North Central Division's Monetary Values of Fish Committee published *Reimbursement Values for Fish,* addressing species in 12 northern states and 2 Canadian provinces. To integrate these and other regional values, a special AFS Monetary Values of Freshwater Fish Committee collected values from 135 federal, state, provincial, and private agencies and hatcheries. These data were published in 1982 as Part I of AFS Special Publication 13. For the present book, the Socioeconomics Section has repeated the earlier survey to update replacement costs for killed fish and summarized procedures for estimating the broader economic losses resulting from a fish kill.”

These potential sources will be used to obtain “off-the-shelf” values that could possibly be relevant to the effected species at the SONGS station. In addition, some of these contacts may be useful as researchers, data sources, and/or witnesses for any hearings that evolve. They may also be useful as peer reviewers or as sources to identify peer reviewers.

Primary Research

There are several other methodologies that could be used to obtain economic values for the species considered, but they will require some level of primary research.

Data and programs could be obtained from the U.S. EPA and examined to see if the results reported in USEPA (2004d) are defensible. If they are not, a new RUM model could be estimated with the data. The major changes introduced in the research would be to consider::

1.) the RS species rather than in a grouping[1];
2.) the San Onofre sites would be delineated rather that using Southern California counties as sites.

The analysis would also update the angling activity and possible generalized the RUM model in ways that current research is including.

Strategy to Obtain Recreational Unit Values per Fish Caught

The initial portion of the study would be to complete a benefits transfer analysis and determine whether or not the values obtained were reasonable for the purposes of the decisions to be made. That is, if the mitigation strategy returned recreational benefits of $100,00 per year and the corresponding costs were $70,000, it would probably be unwise and inefficient to move onto primary research because in all likelihood the estimate of costs would not be significantly larger than the benefits. If however, the benefit transfer method suggested that the benefits were to be small relative to costs, it may be useful to do one of the primary research plans suggested in the previous section. The quality of existing studies would also be a determinant.

Discussions with key informants in the benefit transfer work would determine the availability and reliability of data from the previous studies of recreational fishing. In addition, some notion of the potential improvement in estimates from using new data and a new model would be obtained.

With this information and a better understanding on the costs of doing the primary research studies, decisions regarding what combination of benefit transfer and primary research would be most advantageous. The primary research would in all likelihood provide better estimates of value but may be more costly. Given the present information, it is likely that the analysis performed by the U.S. EPA in 2004 could be used. Additional effort would be devoted to determining whether the aggregation of sites and species could cause the estimated values to be biased.

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[1] For example, queenfish is considered in the category “bottomfish” in previous studies. If there were sufficient anglers targeting queenfish, then a category queenfish could be designated.

Commercial Fishing

The first determination would be whether commercial fishing is affected by reduced mortality to effected species. The National Marine Fisheries Service would be consulted regarding species that the impingement and entrainment studies identified. Both producers and consumers could gain from increases in commercial catch, but the assessment would likely only estimate the gains to direct producers, i.e. commercial fishermen. This is based on the expectation that relatively small changes in commercial landings result from reduced IM&E mortalities. This is the approach that EPA took in the 2004 study.

The approach that EPA uses for assessing commercial benefits to producers bases the unit value on the ex-vessel price (sometimes referred to as dockside price) of the species under consideration. The logic of the approach begins with an assumption that harvest increases do not induce effort (inputs used in harvesting) to increase following reductions of entrained and/or impinged organisms. If this were entirely true, then the ex-vessel price times the increase in quantity harvested would represent producers surplus. However, EPA appreciates that this would not likely be true and that effort and costs would undoubtedly increase in the long run in response to increased commercial profits (i.e. producer surplus). In the absence of property rights to the harvest, one would expect the producer surplus to be eliminated. Recognizing this and allowing for uncertainty in effort response, the EPA proposes using a range of 0-40% of the ex-vessel price times the increase in harvest as a measure of the increase in producers' surplus.

In the unlikely event that the change in landings would be relatively large and cause a change in commercial fisheries prices, we would need to collect information on commercial harvests and prices. There is not a good way to use benefit transfer methods for the consumers' surplus although EPA is exploring one proposed by Bishop and Holt (2003). This approach at present does not look that promising.

However, existing data from the National Marine Fisheries Service should be sufficient to estimate an inverse, general equilibrium demand curve (see Just, et al. for a description) for the species in question. With these estimates, the benefits to consumers could be calculated.

Non-use Valuation

Subsequent study by biologists will determine whether there is a necessity to assess non-use values. Based on current knowledge, it does not appear necessary to estimate them.

But, in the unlikely event that non-use values will have to be estimated, we would look to using a benefit transfer approach or doing primary research for SONGS. Based on the draft Strategic Compliance Plan, we do not believe that the magnitude of the non-use values would justify undertaking a primary research study for non-use values associated with the Potomac River station.

Thus, if non-use values were needed, we would suggest using a benefit transfer method in all likelihood. There have not been any studies of non-use values associated with power plant activities *per se*. People have had to rely on studies associated with other types of activities. For example, EPA used a benefit transfers approach in their Proposal for the 316(b) regulations and in the NODA. EPA (Tudor et al., 2003) reviewed numerous studies of use and nonuse values that were associated with surface water improvements (their Appendix A). Of those shown, only three address both changes in fish populations and non-use values associated with them (Huang, et al. 1997; Whitehead and Groothuis, 1992; Olsen, et al. 1991).

We propose considering these three studies in addition to doing a review of the recent literature. The recent literature may be important because EPA has placed some emphasis on this ecological valuation recently. For example, there is a meeting entitled "Improving the Valuation of Ecological Benefits, a STAR Progress Review Workshop" that was held in Washington in October, 2004. The papers presented at that workshop are now available on the internet. One of them is directly related to California.

The results of this activity would likely be the development of a relationship (specifically a ratio) between use values and non-use values. For years, EPA used the 50% rule, a practice that implied that nonuse values were 50% of use values. Our approach, just like some of their 316(b) efforts (Tudor 2003), would be to refine this ratio for situations more akin to the changes associated with power plant operations.

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Appendix

C WRITTEN FISH AND WILDLIFE AND OTHER REGULATORY AGENCY CORRESPONDENCE

See following pages.

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Staff: JJL, SMH—SF
Staff Report: March 25, 2005
Hearing Date: April 14, 2005

STATUS REPORT ON SONGS MITIGATION PROGRAM JANUARY – MARCH 2005

Following is a brief status report for the January-March 2005 period for the mitigation projects required in Southern California Edison Company's (SCE) coastal development permit for the San Onofre Nuclear Generating Station (SONGS) Units 2 and 3 (permit no. 6-81-330, formerly 183-73). The Commission originally adopted the conditions in 1991 to mitigate the adverse impacts of the power plant on the marine environment. The 1991 conditions (Condition D) also require SCE to provide the funds necessary for Commission technical oversight and independent monitoring of the mitigation projects, to be carried out by independent contract scientists under the direction of the Executive Director. In 1993, the Commission added a requirement for the permittee to partially fund construction of an experimental fish hatchery. The Commission has since approved amendments to the conditions in April 1997 and October 1998.

Implementation of the mitigation projects is the responsibility of SCE whereas the Commission is responsible for implementing its independent monitoring and technical oversight function, including the wetland pre-restoration monitoring program and experimental reef monitoring program described below. The Commission has operated under approved work programs and budgets since 1993. The Commission unanimously approved the work program and budget for calendar years 2004 and 2005 in November 2003.

Another aspect of the Commission's monitoring and oversight is periodic public review of the performance of the mitigation projects. The staff and contract scientists last conducted workshops on the San Dieguito wetland and reef mitigation projects in February and March 2004, respectively. Slides of the wetland workshop presentations (in PDF format) and proceedings of the reef workshop are posted on the Coastal Commission website at www.coastal.ca.gov. The 2005 public review workshop for the reef mitigation project is currently scheduled for May 26 in San Clemente. The workshop for the wetland restoration project will be scheduled over the next few months. Final dates, times and agendas will be posted on the Commission's website.

WETLAND RESTORATION MITIGATION

The Project

Condition A of the permit requires the permittee to create or substantially restore a minimum of 150 acres of wetlands to mitigate for the reduction in the standing stocks of nearshore fishes caused by the operation of SONGS. In April 1997, the Commission reaffirmed its 1992 approval of the permittee's choice of the San Dieguito River Valley as the site for the wetland restoration project and allowed for up to 35 acres credit for enhancement at San Dieguito Lagoon on the condition that the ocean inlet is maintained open to tidal flow in perpetuity.

Progress Report

Wetland Restoration Project. The Commission approved SCE's preliminary wetland restoration plan for the San Dieguito Lagoon in November 1997. The CEQA/NEPA environmental review incorporated the mitigation project into the overall San Dieguito River Valley Regional Open Space Park project. The lead agencies for the CEQA/NEPA review were the San Dieguito River Valley Regional Open Space Park Joint Powers Authority (JPA) and the U.S. Fish and Wildlife Service (USFWS).

In September 2000, the JPA certified the EIR after public hearing. The EIR/S designated the Mixed Habitat plan as the environmentally preferred alternative. As required by NEPA, the availability of the final EIR/EIS was published in the Federal Register in September 2000; however, the USFWS had not yet issued a final Record of Decision (ROD) when lawsuits on the Final EIR (FEIR) were filed. The lawsuits have now concluded (see next paragraph). USFWS issued the ROD on November 28, 2003.

Litigation on Final EIR. Lawsuits challenging the adequacy of the FEIR were filed by the Del Mar Sandy Lane Association and Citizens United to Save the Beach. Although in a July 2001 decision the Court rejected certain of the plaintiff's claims, it determined that the FEIR was inadequate with regard to several issues, most significantly that there was insufficient evidence supporting the FEIR's conclusion that the project will not increase scour and loss of sand at the river mouth. The Court set aside the JPA's certification of the FEIR and remanded the matter back to the JPA. Both parties appealed the Court's decision. In August 2003, the Court of Appeal ruled that there is substantial credible evidence supporting each of the JPA's conclusions concerning the environmental impacts of the restoration project and the appropriateness of the mitigation measures, thus reversing the judgment of the trial court. All appeals are final; on October 6, 2003, the Appeals Court issued its order directing the Superior Court to issue the revised judgment.

Outstanding issues/Next steps in implementing wetland restoration. The permit requires SCE to submit a final wetland restoration plan and coastal development permit application to the Commission and to obtain other agency approvals and permits. The plan submitted must substantially conform to the preliminary restoration plan approved by the Commission in November 1997, unless the CEQA/NEPA review concludes that an alternative plan that meets the conditions for minimum standards and objectives is the environmentally superior alternative.

Following completion of its final design and engineering plans, SCE began the process of obtaining necessary permits, including its coastal development permit from the Commission. On August 17, 2004, SCE submitted its Coastal Development Permit Application (#6-04-88) to the Commission's San Diego and San Francisco offices. The Commission's contract scientists and staff are continuing to review the application and associated documents submitted in response to staff's non-filing letters of September 16 and November 30, 2004, and March 11, 2005. Once staff determines that all of the additional required information is submitted, the application can be filed complete. Staff is working with SCE, its contractors, and staffs of the relevant resource and regulatory agencies to help SCE provide necessary information. Staff hopes to bring the CDP application to the Commission in summer 2005.

Two other issues remain to be resolved before the Commission considers the final plan and coastal development permit application: the 22nd Agricultural District's requirement for Least Tern nesting habitat under its previously granted coastal development permit (CDP No. 6-84-525) and the JPA's proposal for public trails. This quarter the staff has continued its work with the District and representatives of the Attorney General's Office; tentative agreement on the least tern nesting requirement has been reached between the staffs of the Commission and District but has yet to be formalized. The staff expects to bring the agreement to the Commission at the earliest possible meeting.

Consultations regarding the trails are partly dependent upon resolution of the issues with the District since portions of the proposed trail would be placed on District property. SCE revised the CDP application to propose that horses be allowed only on the trail east of the I-5 freeway, and not be allowed to go under the I-5 freeway, relieving one of the staff's major concerns. Staff will have further discussions on the proposed trail with SCE and JPA during the processing of the CDP application.

Pre-restoration Monitoring. The SONGS permit establishes physical and biological performance standards that must be met by the restored wetland. As part of the Commission's technical oversight, monitoring and management responsibilities under Condition D, the contract scientists are conducting pre-restoration monitoring in San Dieguito Lagoon and other southern California wetlands that may be used as reference sites in post-restoration monitoring. Pre-restoration monitoring includes the collection of baseline physical and biological data on the wetland attributes that will be monitored during post-restoration monitoring. Pre-restoration data are required to assess changes in the existing wetland following construction. Pre-restoration monitoring data are also needed to develop sampling designs for post-restoration monitoring that can effectively determine whether the various performance standards have been met. This information has been incorporated into the CCC Monitoring Plan.

Contract scientists continued to analyze pre-restoration data on water quality, invertebrates and fishes, but have focused most of their attention on finalizing the CCC Monitoring Plan, including the technical appendices, which contain detailed results of pre-restoration monitoring. A draft Monitoring plan is expected to be ready for SCE and resource agency review in April 2005.

The contract scientists continue to monitor water salinity and oxygen concentration, which are important to the health, abundance, and richness of estuarine biota. These baseline data on water quality, and also tidal height, are collected by continuously recording instruments placed in San Dieguito Lagoon and Carpinteria Salt Marsh (a reference wetland).

KELP REEF MITIGATION

The Project

Condition C of the permit requires construction of an artificial reef that consists of an experimental reef and a larger mitigation reef. The experimental reef must be a minimum of 16.8 acres and the mitigation reef must be of sufficient size to sustain 150 acres of medium to high density kelp bed community. The purpose of the experimental reef is to determine which combinations of substrate type and substrate coverage are most likely to achieve the performance standards specified in the permit. The design of the mitigation reef will be contingent on the results of the experimental reef.

In April 1997, the Commission added the requirement for a payment of $3.6 million to the State's Ocean Resource Enhancement and Hatchery Program (OREHP) to fund a mariculture/marine fish hatchery to provide compensation for resources not replaced by the artificial mitigation reef. SCE has fully satisfied this portion of the kelp mitigation requirement.

Progress Report

Following completion of the environmental review and permitting process, construction of the experimental reef located off San Clemente was completed in September 1999. The experimental reef tests eight different reef designs that vary in substrate composition (quarry rock or recycled concrete), substrate coverage (actual coverages are higher than the intended nominal coverages of 17%, 34% and 67%, at approximately 54%, 65%, and 84%, respectively), and presence or absence of transplanted kelp on quarry rock modules with a nominal coverage of 34%. All eight reef designs are represented as individual 40 m x 40 m modules that are replicated in seven areas (i.e., blocks) for a total of 56 artificial reef modules totaling 22.4 acres. Efforts to transplant kelp were deemed successful in 2001. Dense natural recruitment of kelp, however, also occurred on all reefs and swamped the effect of kelp transplantation. Consequently, kelp densities did not differ between reefs with and without transplanted kelp and, therefore, monitoring of the two reef designs with transplanted kelp was discontinued in 2001. The results presented below are for the remaining six designs, which represent different combinations of substrate cover and type.

Results from Experimental Reef Monitoring. The monitoring plan approved by the Commission specifies that the abundance of giant kelp, macro invertebrates, understory algae, and kelp bed fish, and the area and coverage of hard substrate on the artificial reef modules be surveyed each year for five years.

Results from the first four years of the five-year artificial reef experiment were reviewed at an annual public workshop held at the San Clemente Community Center in March 2004 (Proceedings from the Fourth Annual Public Workshop of the SONGS Mitigation Project Condition C: Kelp Forest Mitigation are posted on the Coastal Commission website at www.coastal.ca.gov). The major focus of the workshop was on the effectiveness of the different experimental reef designs in supporting kelp forest biota. The effectiveness of the different reef designs was gauged in relation to their ability to meet the fixed and relative performance standards that will be used to judge the success of the 150-acre mitigation reef. The results presented at the workshop revealed three major concerns about some or all of the artificial reef designs:

1. There is a potential for dominance of all reef designs by the sea fan, *Muricea*.
2. Dominance by *Muricea* and possibly other benthic invertebrates could inhibit the sustainability of giant kelp and thus prevent the artificial reef from succeeding in meeting the performance standard for giant kelp.
3. None of the reef designs currently meet the permit standards for the abundance and richness of understory algae whose mean values are diverging from the natural reference reefs on all reef designs.

Two studies are currently underway and will continue through 2005 to address these areas of concern. One is a continuation of demographic studies the sea fan *Muricea* spp. These studies are providing information necessary to make projections regarding the densities of large adult sea fans likely to become established on the different reef designs. A second study was established to determine the relative importance of competition by invertebrates and shading by adult giant kelp on the abundance and species richness of understory algae and on the abundance of juvenile giant kelp. Results from these studies will provide much needed insight into whether one or more designs are heading inexorably toward dominance by benthic invertebrates (which would prevent them from meeting the performance standards for giant kelp and understory algae) or whether the patterns are due primarily to the more ephemeral effects of shading by adult kelp. Information gained from these studies will be extremely useful in deciding on the eventual design of the 150-acre mitigation reef.

Year-Five monitoring of the artificial reef modules and reference reefs was completed in December 2004. The main focus of work during the first quarter of 2005 has been on data entry, documentation and quality control. Contract scientists have begun analyzing data and are planning on having a draft final report with recommendations on the general design of the mitigation reef available for review at the annual public review workshop currently scheduled for May 26, 2005 in San Clemente. Contract scientists continue to explore the suitability of different methods for evaluating the performance standard pertaining to fish production of the mitigation reef. On February 28 and March 1, 2005, the contract scientists, Commission staff and Science Advisory Panel met with three fish experts to discuss the pros and cons of different methods of estimating fish production and to develop a cost-effective plan for future work on this topic.

FISH BEHAVIORAL MITIGATION

The Project

Condition B requires the permittee to install and maintain behavioral barrier devices at SONGS to reduce fish impingement losses.

Progress Report

SCE conducted a number of laboratory and in-plant experiments testing the behavioral response of fish to lights and sound devices from 1992 through 1999. None of the experiments showed evidence that these devices would reduce fish impingement losses as required by Condition B. At the same time, SCE continued its modified heat cleaning treatments at the plant (called the Fish Chase procedure), which result in a considerable reduction in fish impingement

In October 2000, the Commission reviewed the results and concluded that no further testing of alternative behavioral barriers should be required at this time, provided that (1) SCE continues to adhere to the operating, monitoring, and reporting procedures for the modified heat cleaning treatments and (2) SCE makes every effort to test and install, if feasible, future technologies or techniques for fish protection if such techniques become accepted industry standards or are required by the Commission in other power plant regulatory actions.

The contract scientists' review of the data and analyses on the fish chase procedure at SONGS contained in SCE's 2003 *Annual Marine Environmental Analysis* report indicated that the fish chase procedure in 2003 was consistent with the Commission's requirements and that SCE continues in compliance with Condition B of the SONGS permit.